T. O. 1C-131A-1

FLIGHT MANUAL

USAF SERIES C-131A AIRCRAFT

CONTRACTS AF33(600)-5928, AF41(608)-16161

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE.

THIS CHANGE INCLUDES SAFETY OF FLIGHT SUPPLEMENTS -10 AND -11. SEE BASIC INDEX T.O. 0-1-1 AND WEEKLY INDEX T. O. 0-1-1A FOR CURRENT STATUS OF SAFETY OF FLIGHT SUPPLEMENTS.

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AFPS SA FEB 63, 2000

31 MARCH 1961

CHANGED 25 SEPTEMBER 1962

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CURRENT FLIGHT CREW CHECKLISTS

T.O. 1C-131A-CL-1-1
25 January 1962, Changed 25 September 1962
T.O. 1C-131A-CL-1-1-1
25 September 1962

*The asterisk indicates pages changed, added, or deleted by the current change.

ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED AS FOLLOWS:

USAF ACTIVITIES.—In accordance with T.O. 00-5-2.

E-3
USAF

SAFETY OF FLIGHT SUPPLEMENT SUMMARY

The initial Safety of Flight Supplement has the technical order number T.O. 1C-131A-SF-1-1. The last digit, -1, denotes the initial supplement. The digit will be changed consecutively to reflect each new supplement. For example, the fifth supplement in a series will be T.O. 1C-131A-SF-1-5. A supplement number will not be repeated, and supplements will normally be received in sequence. If one is missing refer to the Safety of Flight Supplement Index T.O. 0-1-1A to determine whether it was issued or is still in effect. The supplement may not have been distributed because of replacement or rescission. If it was issued and is still active obtain a copy from your Publications Distribution Officer.

SUMMARY OF SAFETY FLIGHT SUPPLEMENTS COVERED IN THIS CHANGE

Number	Date	Short Title	Disposition/ Page No.
-10	10 Apr 1962	Electrical fires	3-20
-11	20 Apr 1962	Rotating propeller warning	2-9, 2-28

SAFETY OF FLIGHT SUPPLEMENT STATUS

This portion to be filled in with outstanding SFS and added to as you receive additional supplements. Refer to Safety of Flight Supplement Index T.O. 0-1-1A for latest information.

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SCOPE... This manual contains the necessary information for safe and efficient operation of the C-131A airplane. These instructions provide you with a general knowledge of the airplane, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore basic flight principles are avoided.

SOUND JUDGMENT... Instructions in this manual are for a crew inexperienced in the operation of this airplane. This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc., may require modification of the procedures.

PERMISSIBLE OPERATIONS... The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from SAAMA (SANEOF) before any questionable operation is attempted which is not specifically permitted in this manual.

STANDARDIZATION AND ARRANGEMENT... Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into ten fairly independent sections to simplify reading it straight through or using it as a reference manual. The first three sections must be read thoroughly and fully understood before attempting to fly the airplane. The remaining sections provide important information for safe and efficient mission accomplishment.

CHECKLISTS... The Flight Manual contains only amplified checklists. Abbreviated checklists have been issued as separate technical orders – see the back of the title page for T.O. number and date of your latest checklists. The Pilots' Abbreviated Flight Crew Checklist consists of three parts, normal procedures, emergency procedures, and performance data. The numbered items (line items) correspond to identically numbered items in the amplified procedures of Sections II and III. Emergency procedures are identified by a red and black striped border. A Takeoff and Landing Data Card is included at the end of the performance data checklist. The abbreviated checklist does not replace the amplified version of the procedures in the Flight Manual. To fly the airplane safely and efficiently, you must read and thoroughly understand why each step is performed and why it occurs in a certain sequence. A scroll checklist, authorized by AFR 60-9, is available.

CHECKLIST CONCURRENCY... As changes are made to the amplified checklists in the Flight Manual, concurrent changes will be made to the abbreviated checklist so that both will agree. However, a change to the Flight Manual may not affect the amplified procedures; therefore, the Flight Manual date may not be the same as the checklist date. To determine the checklist applicable to a given Flight Manual issue, refer to the bottom of the Flight Manual "A" page under "Current Flight Crew Checklist." For purposes of determining the concurrency between the Flight Manual and the checklist, the latest date of the Safety of Flight Supplement affecting the checklist will be considered to represent the latest change date of the Flight Manual.

SAFETY OF FLIGHT SUPPLEMENTS... Information involving safety will be promptly forwarded to you by Safety of Flight Supplements. Supplements covering loss of life will get to you in 48 hours by TWX, and those concerning serious damage to equipment within 10 days by mail. The current status of each Safety of Flight Supplement affecting your airplane can be determined by referring to the Weekly Index of Safety of Flight Supplements (T.O. 0-1-1A). The title page of the Flight Manual and the title block of each Safety of Flight Supplement should also be checked to determine the effect they may have on existing supplements. You must remain constantly aware of the status of all supplements – current supplements must be complied with but there is no point in restricting your operation by complying with a replaced or rescinded supplement.

SAFETY OF FLIGHT CHECKLIST CHANGES... Whenever you receive a Safety of Flight Supplement affecting your checklist, write in the appropriate information. Printed replacement checklist pages will be made available to you as quickly as possible through the "quick change" checklist program. A notation on the bottom inside corner of these pages will indicate that they reflect certain Safety of Flight Supplements; however, discarding a Safety of Flight Supplement is authorized only through the title page of the Flight Manual or T.O. 0-1-1A.

HOW TO GET PERSONAL COPIES... Each flight crew member is entitled to personal copies of the Flight Manual, Safety of Flight Supplements, and checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your supply personnel – it is their job to fulfill your technical order requests. Basically, you must order the required quantities on the Publication Requirements Table (T.O. 0-3-1). Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS... Loose leaf binders and sectionalized tabs are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your abbreviated checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders, respectively. Check with your supply personnel for assistance in securing these items.

WARNINGS, CAUTIONS, AND NOTES... The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual:

WARNING

Operating procedures, techniques, etc., which will result in personal injury or loss of life if not carefully followed.

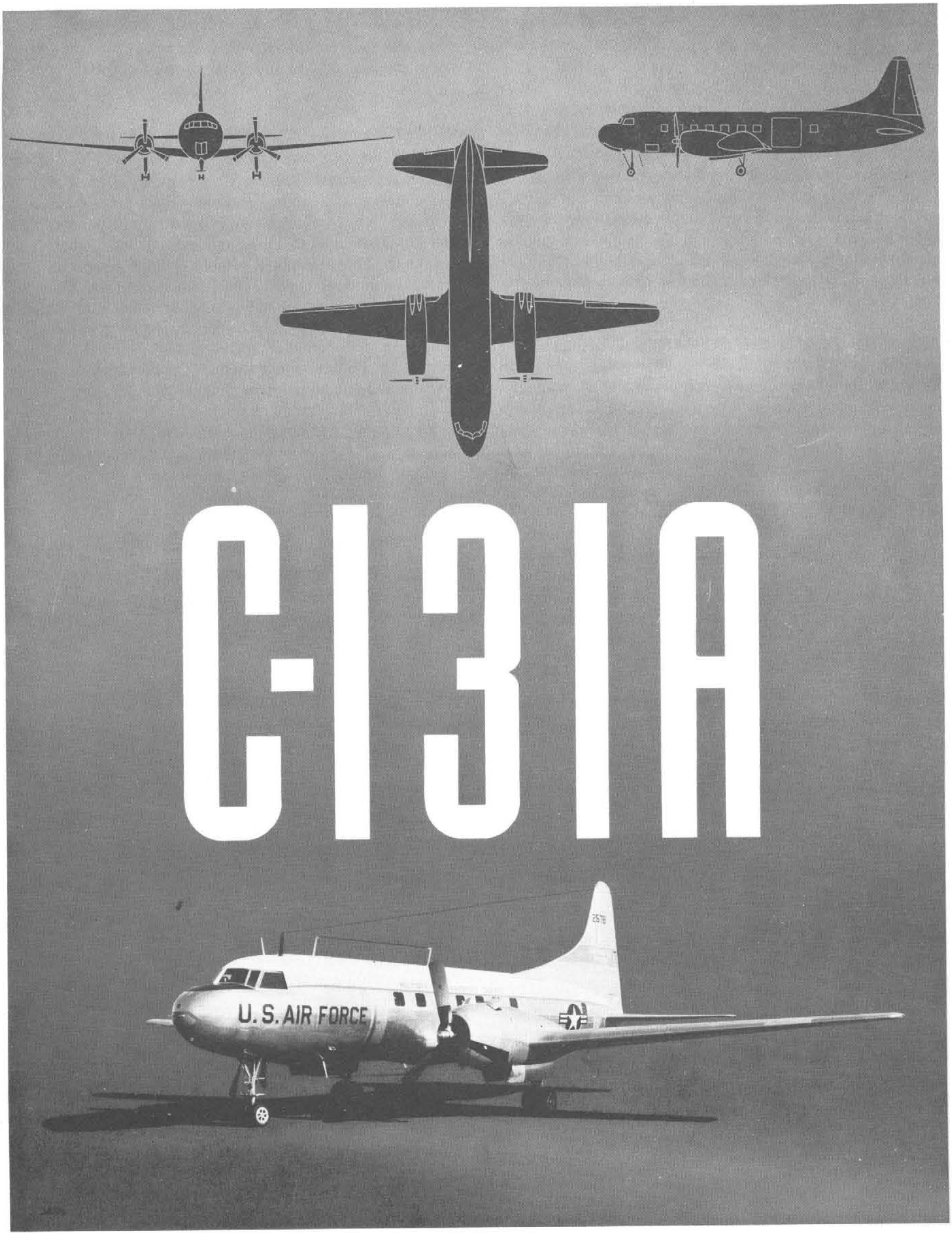
CAUTION

Operating procedures, techniques, etc., which will result in damage to equipment if not carefully followed.

Note

An operating procedure, technique, etc., which is considered essential to emphasize.

YOUR RESPONSIBILITY—TO LET US KNOW... Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcomed. These should be forwarded through your Command Headquarters to SAAMA (SANEOF), Kelly AFB, Texas.


C-131A
U.S. AIR FORCE
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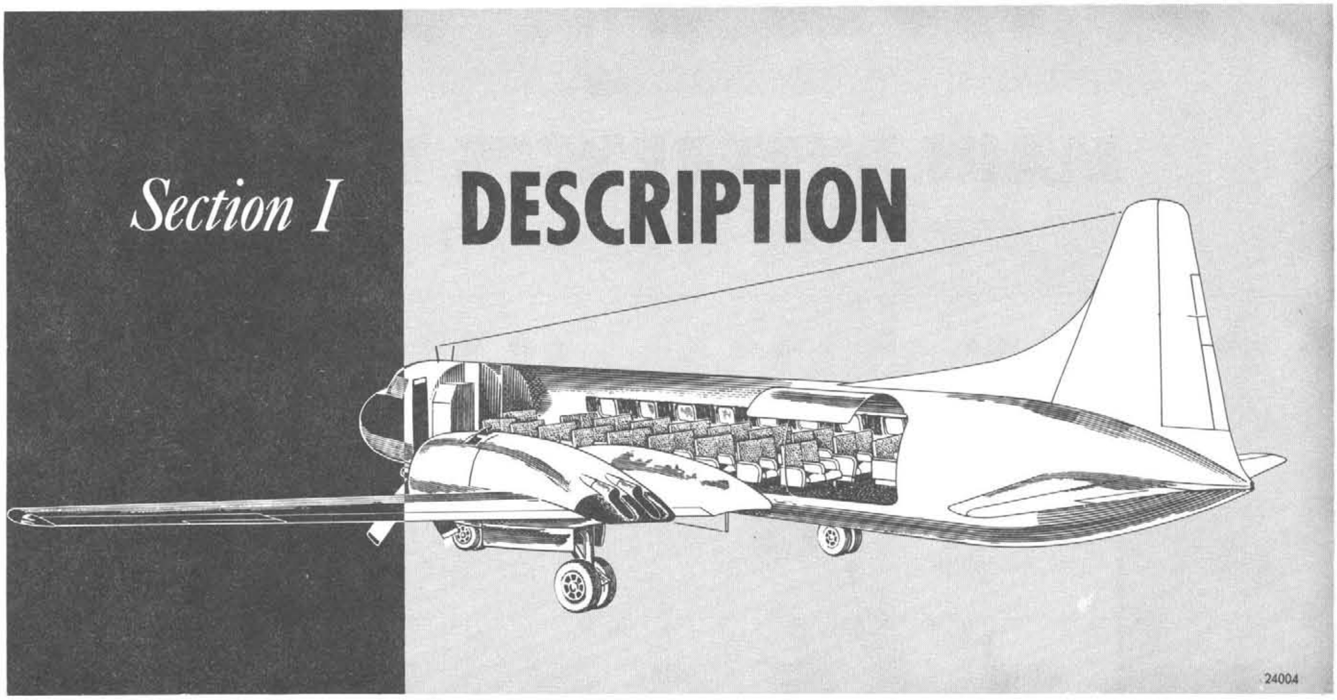
Section I DESCRIPTION



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THE AIRPLANE

The C-131A airplane is a two-engine, low-wing monoplane that can be used alternately, or in combination, as an air evacuation transport, a personnel transport, or a light cargo carrier. It is powered by two reciprocating engines with full feathering hydromatic propellers. Reverse thrust is available for aerodynamic braking on the ground. The pressurized cabin can be completely equipped for air evacuation missions using seats, litters, and appropriate food and medical supplies for 34 passengers, including medical attendants. As a personnel transport, 39 aft facing seats can be installed with appropriate food and water supplies. A hydraulically operated

MAIN DIFFERENCES TABLE

ITEM	C-131A	VC-131A	C-131B	C-131D	C-131E
ENGINES	R-2800-99W	R-2800-99W	R-2800-103W	R-2800-103W	R-2800-103W
MISSION	Air Evacuation	Transport	Airborne Electronic Test Bed	Transport	Air Evacuation
CARGO DOOR	Yes	Smaller Service Door	Yes	Smaller Service Door	Yes
ASTRODOME	No	No	Yes	No	No
RADOME	No	No	Provisions	No	No
CABIN COMPRESSOR	Hydraulic Motor Driven	Hydraulic Motor Driven	Engine Driven	Engine-Driven	Engine-Driven
ALTERNATORS	1 Engine Driven 1 Hydraulic Motor Driven	1 Engine Driven 1 Hydraulic Motor Driven	No	2 Engine-Driven	2 Engine-Driven
GALLEY	Yes	Yes	No	Yes	Yes
PASSENGER ACCOMODATIONS	39 Seats or 27 Litters	32 Seats 27 Seats (Executive)	Provisions for 48 Seats	44 Seats 23 Seats (Executive)	18 Seats and 12 Litters
AUXILIARY POWER UNIT	No	Yes	Pods (Some Airplanes)	No	No
EXHAUST SILENCERS	No	Maxim	No	Rectangular	Rectangular

24005

Figure 1-1

entrance door on the right side of the fuselage forward of the wing, encloses an integral stairway that unfolds into loading position as the door opens and folds up into the fuselage as the door closes. A larger litter-loading door is installed on the aft left side of the fuselage. Each unit of the retractable tricycle landing gear has dual wheels and the nose wheel is steerable. All duties connected with operating the airplane itself can be performed by the basic flight crew consisting of a pilot, copilot, and flight mechanic.

Dimensions

Wing span	91 feet, 9 inches
Length	74 feet, 8 inches
Height	27 feet, 3 inches
Tread	25 feet, 0 inches

Gross Weight

This airplane is in the 40,000-lb. class. Refer to Section V for detailed gross weight and loading information.

ENGINES

The airplane is powered with two Pratt and Whitney Double Wasp R-2800-99W engines having integral two-speed engine blowers and using water injection for power increases of limited duration. Engine exhaust augmentors are provided to assure adequate engine cooling. The augmentors are large tubes that extend aft from the firewall to the wing trailing edge (figure 1-8). Two augmentors are installed in each nacelle. Exhaust stacks carry the exhaust gases from the cylinders to the forward ends of the augmentors. Open space remains around the stacks where they terminate at the augmentors. Each augmentor functions as an ejection pump to draw cooling air across the engine, and utilizes the heat energy in the exhaust gas and engine cooling air for additional thrust. Part of the engine cooling air enters muffs around the augmentors and becomes the heating air for the wing and tail anti-icing system and the heat exchanger of the cabin air-conditioning system. Carburetor air is taken from an integral ram air scoop in the engine cowl upper panel. Oil cooling and accessory cooling air is taken from a flush scoop in the lower panel of each cowl. A ventilation door in the nacelle top cowl panel allows air to flow continuously through the engine accessory section. It is normally held open by a lock pin, but closes automatically and stays closed if the fire extinguishing agent is discharged. Four adjustable nacelle flaps are provided for each engine to facilitate cylinder head temperature control. When the throttles, mixture control levers, or carburetor heat control levers are positioned, an anti-creep device in the pedestal quadrant automatically seizes the controls and prevents reverse cable loads from moving them inadvertently. Normal operation of any of the controls instantly releases the anti-creep device in respect to that control and allows easy operation to the new setting, when the anti-creep device again takes effect.

ENGINE CONTROLS

Throttles

Dual throttles (11, 19, figure 1-11) are provided for both the pilot and the copilot on the quadrant section of the pilots' pedestal. Each throttle quadrant has a forward thrust range, OPEN, a reverse thrust range, REVERSE OPEN, and a neutral midposition, CLOSE. Each throttle quadrant is provided with a detent at the CLOSE position and with a latch stop that prevents the throttle from being pulled aft into reverse thrust range unless the airplane is on the ground (main landing gear struts compressed). Two additional latch stops prevent movement of the throttles into the full-power reverse-thrust positions until the propeller blades have reached the full reverse pitch of −25°. The propellers are unreversed by moving the throttles forward to, or beyond, the CLOSE detents. Throttle position electrically governs (to some extent) the operation of the propeller auto-feathering, water injection, and the landing gear warning systems.

Mixture Control Levers

Two mixture control levers (12, figure 1-11), one for each engine, are provided on the right side of the pilots' pedestal quadrant. Each lever has three operating positions. IDLE CUT OFF, the full aft position, stops the engine by stopping fuel flow at the carburetor. The AUTO LEAN position provides automatic proportioning of the fuel-air mixture in a lean ratio. AUTO RICH, the forward position, provides a rich mixture of fuel and air automatically adjusted to the power setting and altitude. In addition, the mixture control mechanism provides adjustment for manually leaning the fuel air mixture for cruise. Refer to CARBURETOR MIXTURES, Section VII.

Carburetor Heat Control Levers

Two carburetor heat control levers (7, figure 1-11) on the right side of the pilots' pedestal quadrant mechanically open and close the carburetor heat doors in the nacelles. When the levers are in COLD (fully forward) position, outside air enters the carburetors through the carburetor air inlet ducts. When the levers are in HOT (fully aft) position, the carburetor heat doors close off the inlet ducts and all carburetor air is taken from the engine sections of the nacelles.

ENGINE BLOWERS

Each engine incorporates a single-stage, two-speed engine blower (supercharger). In low ratio, blower speed is 7.29 times engine speed. In high ratio, the blower speed is 8.58 to 1. Provisions are made for selection of the desired blower speed by the pilots. Refer to Section VII for blower operation.

Engine Blower Switches

Two engine blower switches (14, figure 1-11) control dc power to the blower shift mechanism. The switches

GENERAL ARRANGEMENT

Litter

(TYPICAL)

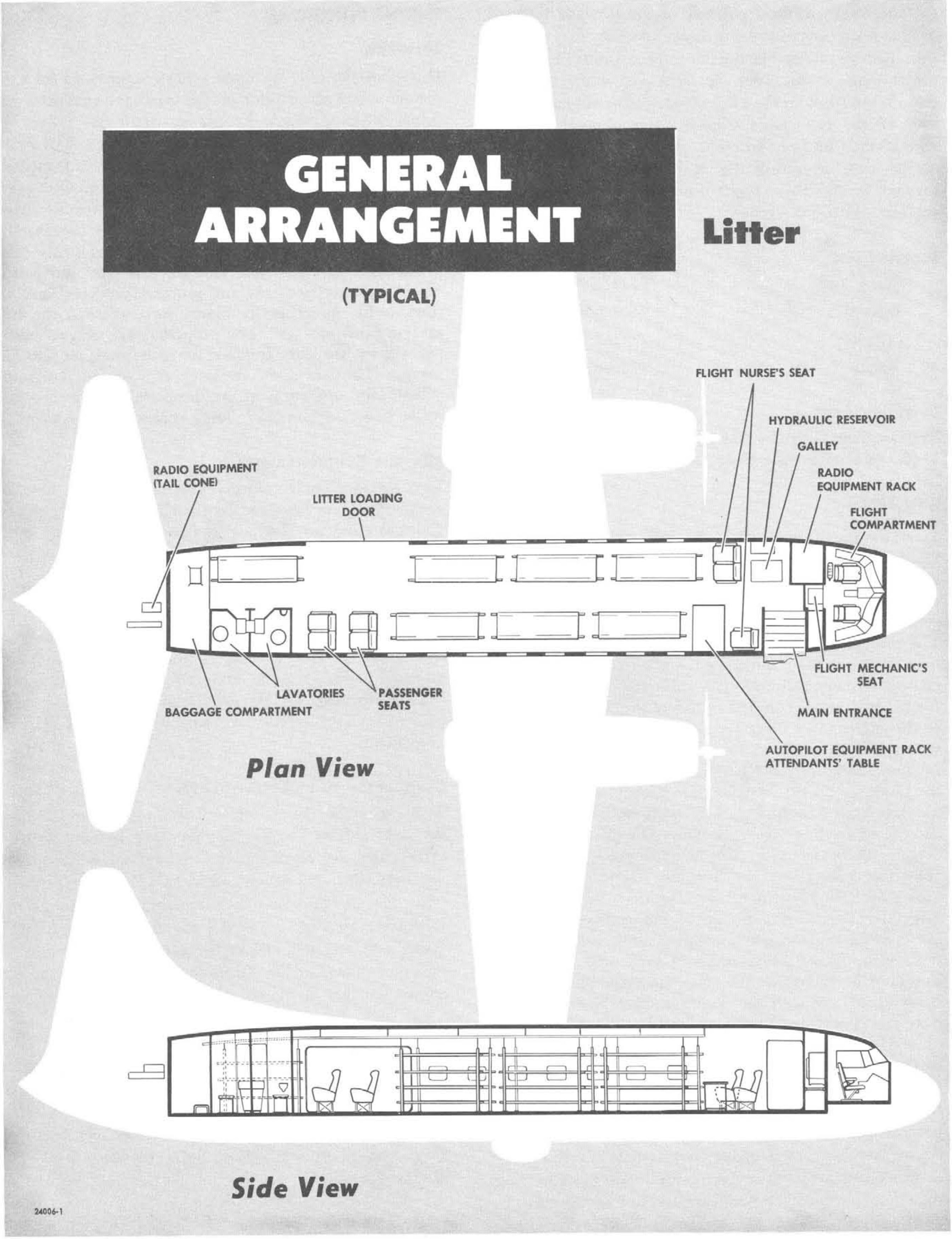
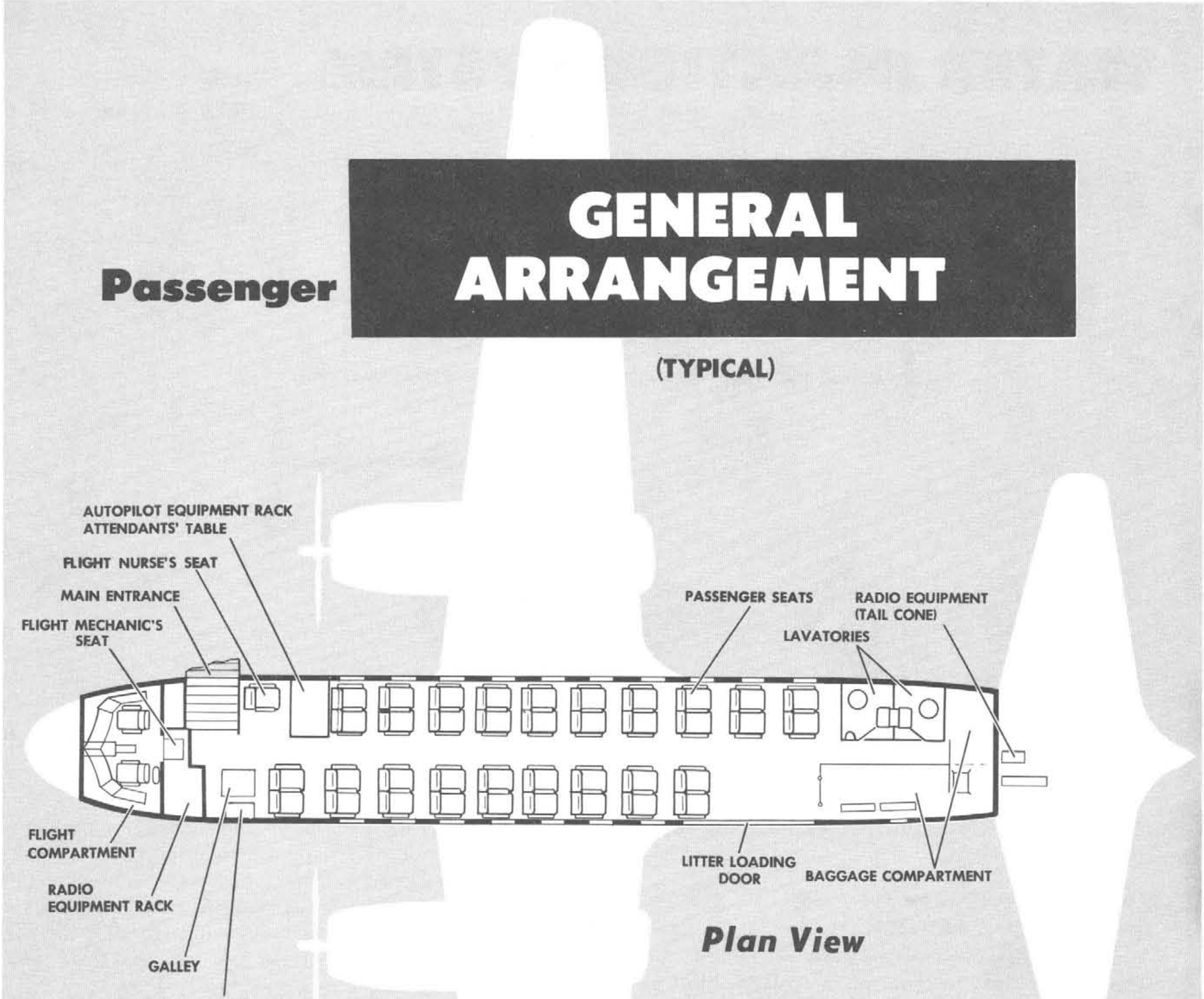


Figure 1-2

Passenger GENERAL ARRANGEMENT

(TYPICAL)



Plan View

Side View

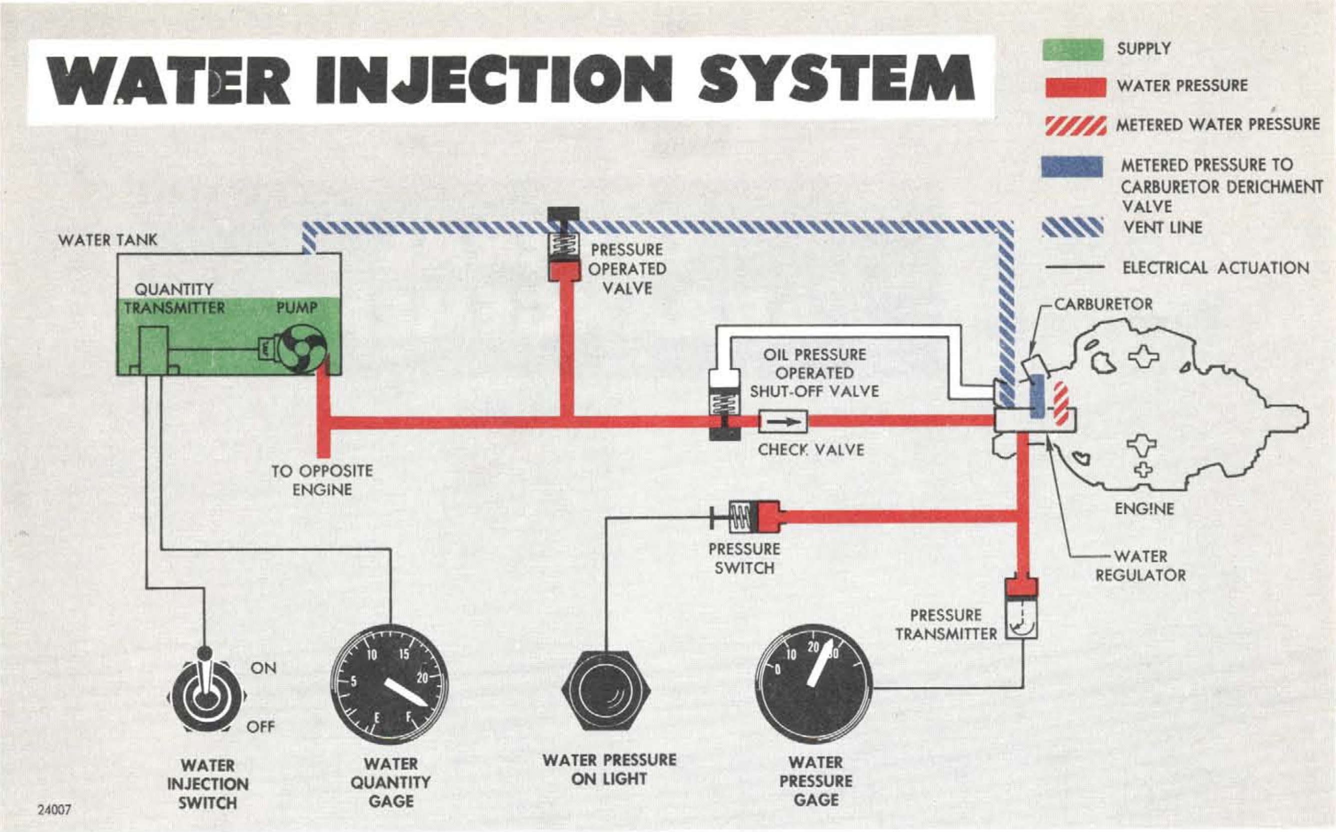


Figure 1-3

have LOW and HIGH positions corresponding to the two speeds of the blowers.

CAUTION

The blower shift mechanism is actuated by a dc solenoid, spring-loaded to the low ratio. If the electrical power supply is cut off while operating in high ratio, the blowers will automatically shift back to low.

WATER INJECTION SYSTEM

A water injection system (figure 1-3) serving both engines is provided to allow operation at greater maximum power and reserve power in event of go-around, obstacle clearance, and similar emergencies. The water injection fluid, commonly called ADI (anti-detonant injection) fluid, or water, is composed of 50% distilled water and 50% methyl alcohol by volume. Ordinarily, operation at excessive manifold pressure leads to detonation. With use of water injection, the fuel flow is automatically decreased while water is introduced with the fuel entering the engine. Refer to WATER INJECTION, Section VII. A tank with a total volume of 25 US gallons, located in the right wing fillet, contains the water supply and the water pressure pump. A switch on the pedestal quadrant controls dc power to the water pump. A switch in a float-operated water quantity transmitter in the tank stops the pump when the water is used down to the three-gallon level to prevent damage to the pump by dry operation. Thus, of the total 25-gallon capacity of the tank, only 22 gallons can be used. Another switch in the tank quantity transmitter permanently opens the power circuit from the water injection switch if the preceding use of water injection has left less than seven gallons in the tank. This prevents use of water injection when there is insufficient water left to complete a wet power takeoff. Water quantity and pressure gages and pressure-on indicator lights are provided on the engine instrument panel. The release of water into inoperative engines is avoided by oil-pressure operated valves in the water injection system, which prevent water flow to the water regulators if engine oil pressure is below 30 psi. The water regulators automatically admit and meter water into the engine fuel feed valve whenever manifold pressures are above approximately 35 to 40 inches Hg. See figure 1-40 for water injection fluid specification.

Water Injection Switch

The water injection switch (13, figure 1-11), has ON and OFF positions. The switch is guarded in the OFF position. It controls dc power to the pump in the water injection tank, arming the system for automatic operation when the necessary conditions of engine power have been met.

Water Injection Indicators

A water quantity gage (24, figure 1-7), two green water-pressure-on indicator lights (22, figure 1-7), and two water pressure gages (20, figure 1-7), are located on the engine instrument panel. The quantity gage registers the amount of fluid in the supply tank, the water-pressure-on indicator lights illuminate when water, at approximately 18 psi pressure or more, is available; and the pressure gages show the pressure of the water. The quantity gage and the indicator lights are dc operated. The pressure gages operate on 26-volt regulated ac power.

ENGINE COOLING

Cooling air (figure 1-8) is drawn across the engine by the jet-pump action of exhaust gases entering the augmentors. The flow of cooling air can be increased by opening the nacelle flaps. Vanes in the aft ends of the augmentors can be positioned to restrict flow of exhaust gases and air through the augmentors. Restricting the flow increases the temperature of the augmentors and the heated air supplied by the augmentor muffs to the airplane's heating and anti-icing systems. Because restricting the flow through the augmentors decreases the amount of cooling air drawn across the engines, cylinder head temperatures are the controlling factors in operation of the augmentor vanes.

Nacelle Flaps

Two nacelle flaps are installed in the top cowl panel and two on the bottom cowl panel of each nacelle. The nacelle flaps are driven by dc powered reversible motors. Opening the nacelle flaps allows engine cooling air to vent directly from the engine section to the outside. When the nacelle flaps are closed, engine cooling air flows through the augmentor tubes along with the exhaust gases. If the cabin is being heated or if the wing and tail anti-icing system is being operated, the nacelle flaps are normally closed in order to direct a strong flow of warm air into the cabin heat exchanger or the wing and tail anti-icing ducts.

Nacelle Flap Switches

Two nacelle flap switches (figure 1-9), one for each nacelle, are provided on the overhead switch panel. Each switch has three positions: MID POSITION, OPEN and CLOSE. In respect to OPEN and CLOSE positions the switches are spring-loaded to an unmarked OFF position. The switches connect dc power to reversible motors at the nacelle flap. When the switches are released to the OFF position the nacelle flaps remain in the position they had reached by that time. This allows precision control of the nacelle flaps. When the switches are placed in MID POSITION, the nacelle flaps open two inches and remain at that setting until the switches are again held to either the OPEN or CLOSE position.

Augmentor Vanes

A vane is installed near the aft end of each augmentor. The vanes are used to raise the temperature of air in the heat collector muffs at the augmentors in order to supply air at maximum temperature to the wing and tail anti-icing ducts or the cabin heat exchanger. The vanes in the two augmentors in each necelle are linked to a dc powered actuator. The actuator is energized to close or trail the vanes by operation of the vane switch when the heat anti-icing system is operating or the augmentor vane arm switch is in the ARM position. The vanes are normally kept in trail position. To protect the augmentors, thermally operated dc circuits will turn the vanes to trail if an overheat condition develops in the heat collector muffs at the augmentors. The vanes cannot be operated to closed or partly closed position as long as the overheat condition exists. The pilot is warned of the overheat condition by persistent ringing of the augmentor overheat warning bell in the flight compartment.

Augmentor Vane Arm Switch

An augmentor vane arm switch (figure 4-2), located on the copilot's console, opens and closes the dc curcuit to the augmentor vane switches when wing and tail anti-icing is not in operation. The switch has positions ARM and OFF. The ARM position connects dc power to the augmentor vane switches and disconnects dc power to the trailing side of the augmentor vane actuators. Whenever the wing and tail anti-icing system is in operation, the augmentor vane switches and the overheat safety circuits are armed regardless of the position of the augmentor vane arm switch. When the augmentor vane arm switch is placed in the ARM position the outboard heat source valves are automatically opened to prevent an overheat condition in the augmentor tubes.

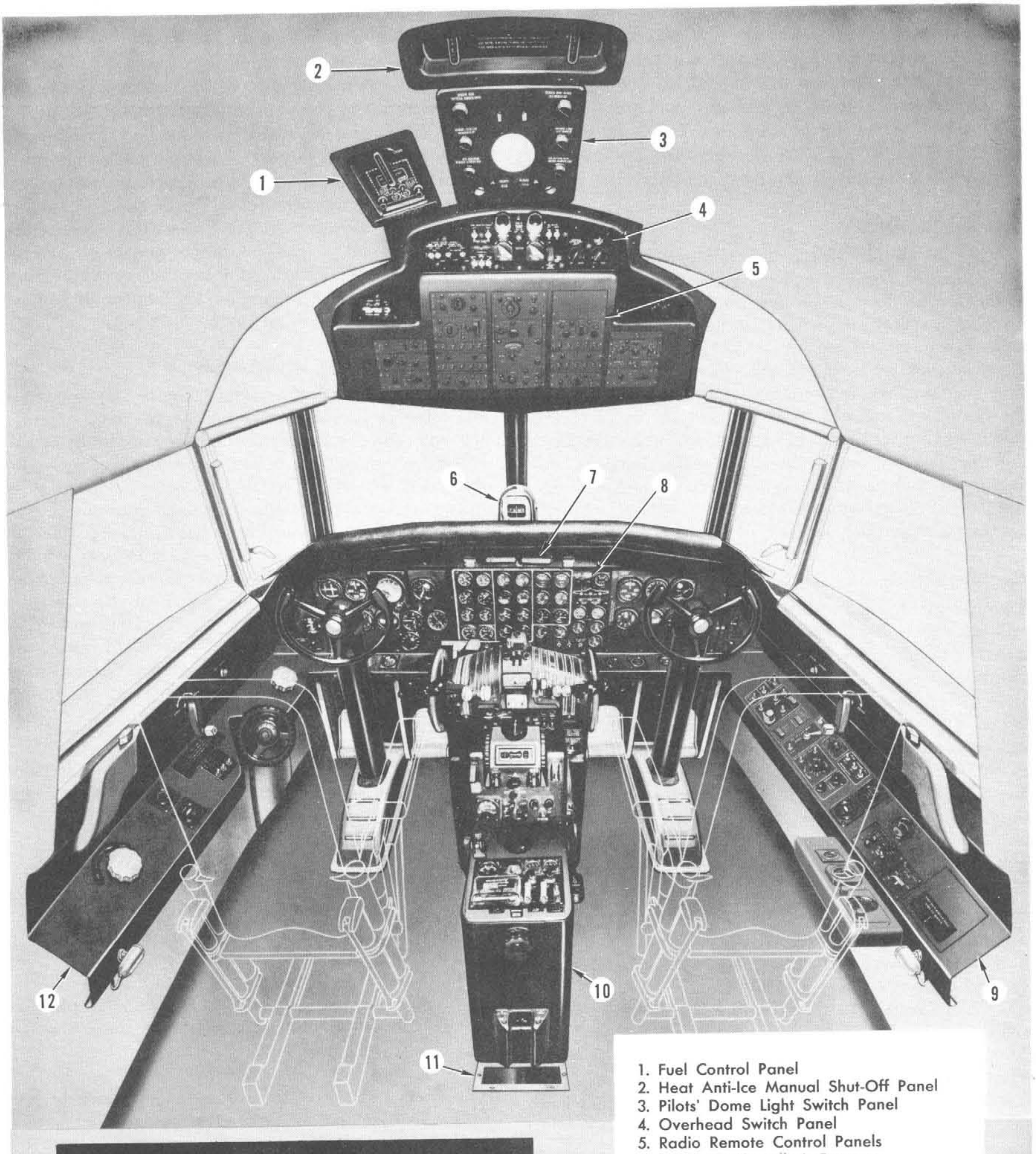
Augmentor Vane Switches

Two switches, located on the overhead switch panel, (figure 1-9) control dc power to either the closing or trailing sides of the augmentor vane actuators.

Note

> The augmentor vane switches are inoperative unless the augmentor vane arm switch is in ARM position or the heat anti-ice button is in PUSH ON position. (Refer to AIR-CONDITIONING SYSTEM and to WING AND TAIL ANTI-ICING SYSTEM, Section IV, for additional information on the use of augmentor vanes.)

The three positions of the augmentor vane switches are: OFF, TRAIL, and CLOSE. The switches are spring-loaded to OFF. Holding the switches in the CLOSE position actuates the augmentor vanes to restrict the flow through the augmentors; holding the switches in the TRAIL position actuates the vanes to their trail positions, so that flow through the augmentors is unrestricted. Releasing the switches to OFF position stops the vanes in the position then indicated by the augmentor vane position indicators. If the augmentor vanes have been positioned to restrict flow through the augmentors and an overheat condition occurs in the augmentors, thermal switches at the augmentors automatically operate the

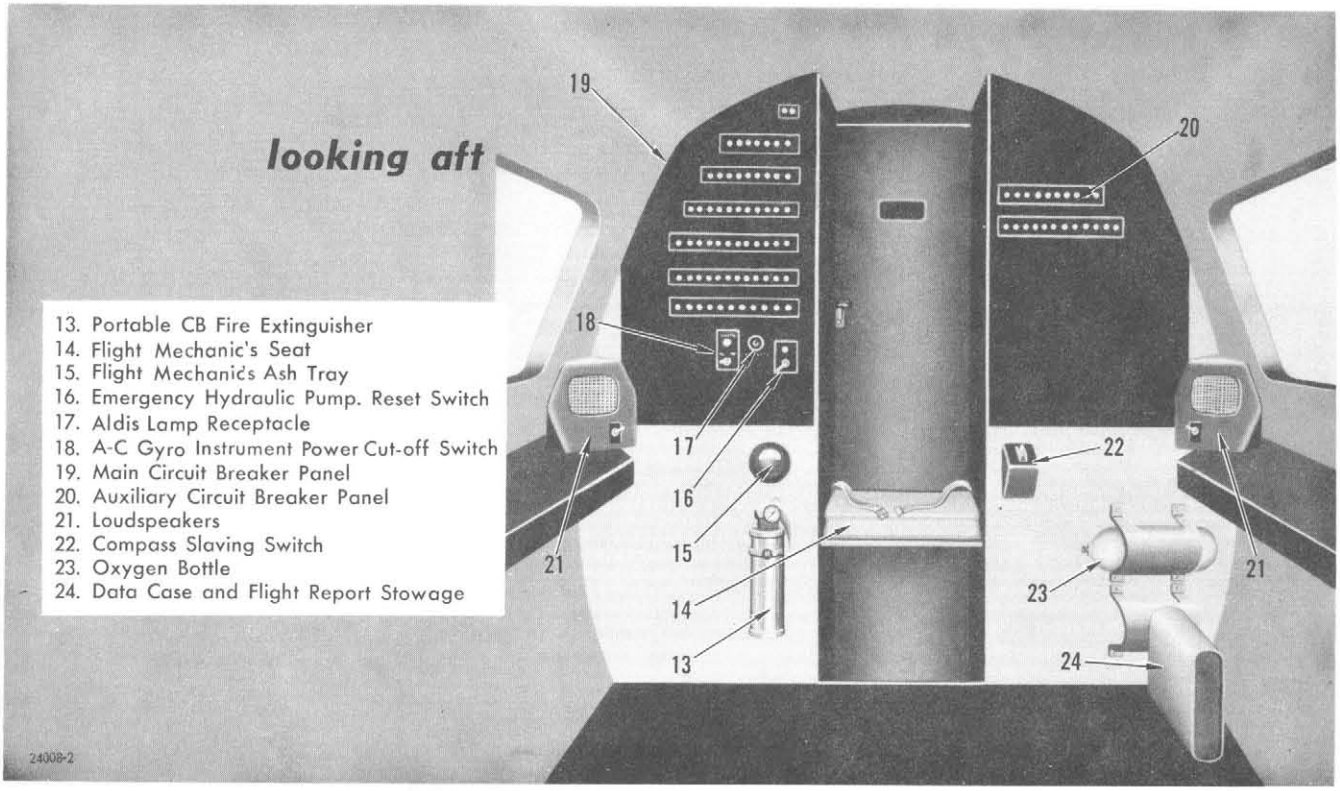


1. Fuel Control Panel
2. Heat Anti-Ice Manual Shut-Off Panel
3. Pilots' Dome Light Switch Panel
4. Overhead Switch Panel
5. Radio Remote Control Panels
6. Magnetic (Standby) Compass
7. Fire Control Panel
8. Flight and Engine Instrument Panels
9. Copilot's Console
10. Pilots' Pedestal
11. Nose Gear Down-Latch Checking Window
12. Pilot's Console

FLIGHT COMPARTMENT

(TYPICAL)

Figure 1-4



13. Portable CB Fire Extinguisher
14. Flight Mechanic's Seat
15. Flight Mechanic's Ash Tray
16. Emergency Hydraulic Pump. Reset Switch
17. Aldis Lamp Receptacle
18. A-C Gyro Instrument Power Cut-off Switch
19. Main Circuit Breaker Panel
20. Auxiliary Circuit Breaker Panel
21. Loudspeakers
22. Compass Slaving Switch
23. Oxygen Bottle
24. Data Case and Flight Report Stowage

augmentor vanes toward the trail position and the augmentor overheat warning bell rings. As long as the warning bell rings, the augmentor vane switches are in an open circuit and have no control over the vane position. When the overheat condition is relieved, control of the vanes automatically reverts to the switches and the vanes will stop further movement.

Augmentor Vane Position Indicators

Two augmentor vane position indicators (33, figure 1-7), one for each nacelle, are located on the engine instrument panel. The pointer of each indicator points to a degrees "CLOSED" indication as long as 26-volt regulated ac power is supplied to the augmentor vane position transmitters. The indicators are operative, therefore, even when the augmentor vane control circuit has not been armed by the augmentor vane arm switch and also when the augmentor vane control circuit has been overridden by the augmentor overheat warning circuit. With loss of ac power, the indicator will continue to read the last position. The vanes will still operate.

Augmentor Overheat Warning Bell

Overheat thermal switches that turn the vanes to trail when overheat occurs also operate an augmentor overheat warning bell on the flight compartment ceiling. The bell continues to ring as long as an overheat condition exists in any augmentor. No cutoff switch is provided. The electrical circuit for the bell is protected by the fire detector circuit breaker on the emergency circuit breaker panel.

WARNING

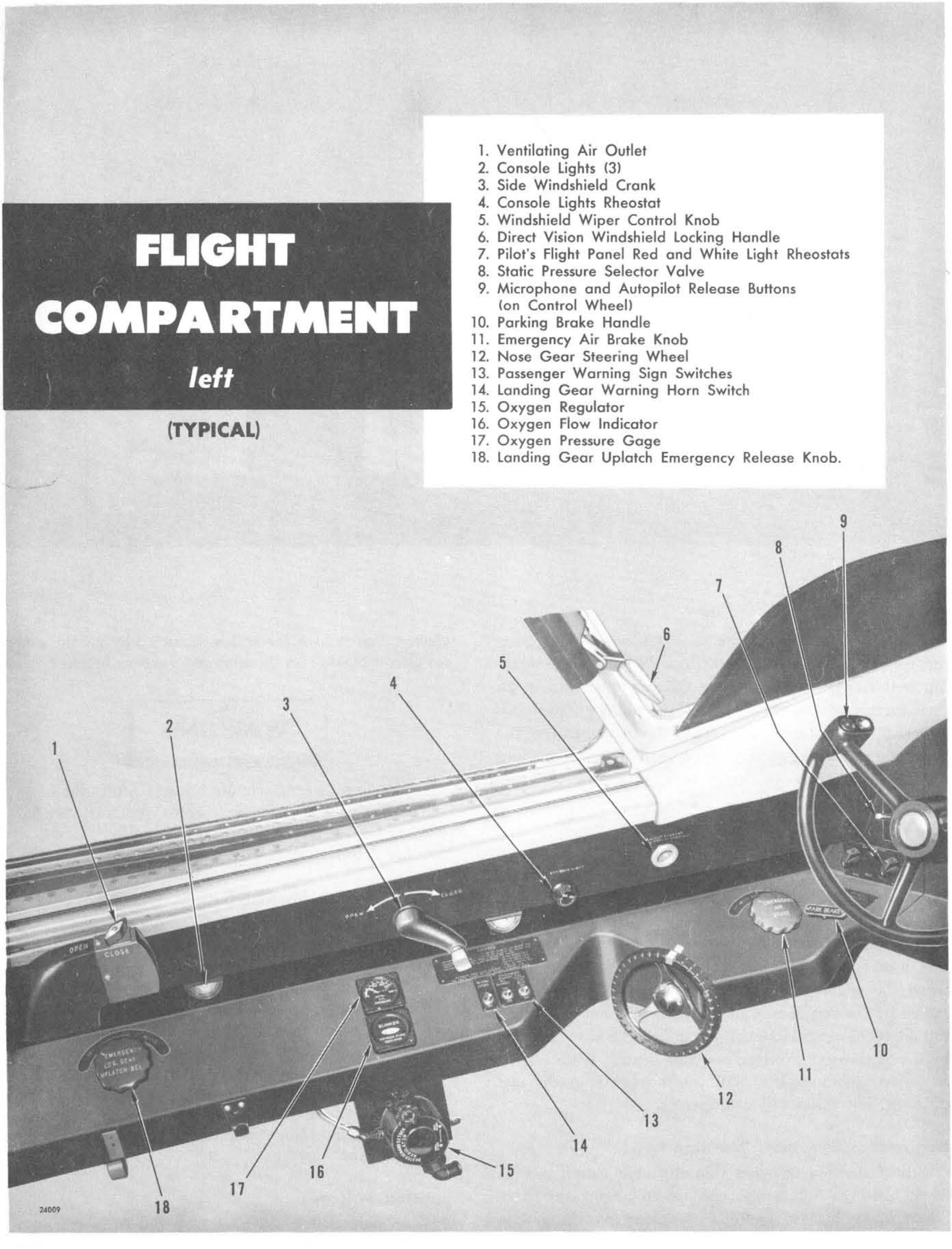
The fire detector circuit breaker must not be pulled to silence the augmentor overheat warning bell. If the circuit breaker is pulled out, the fire detection system is inoperative.

IGNITION AND STARTING

Ignition current is provided by a separate system for each engine. Each system comprises a single-housed dual magneto, two distributors, the necessary ignition coils and relays, and two spark plugs in each cylinder. A vibrator provides ignition boost during engine starting. An ignition switch is provided for each engine. A direct-cranking starter is installed on each engine. Fuel for priming is introduced directly into the engine blower case during starting. An engine starting selector switch routes dc power from the ignition boost, prime, and start switches to the corresponding operating units at each engine during engine starting.

Ignition Switches

Two ignition switches (figure 1-9), one for each engine, are located on the overhead switch panel. Switch positions are OFF, R, L, and BOTH.



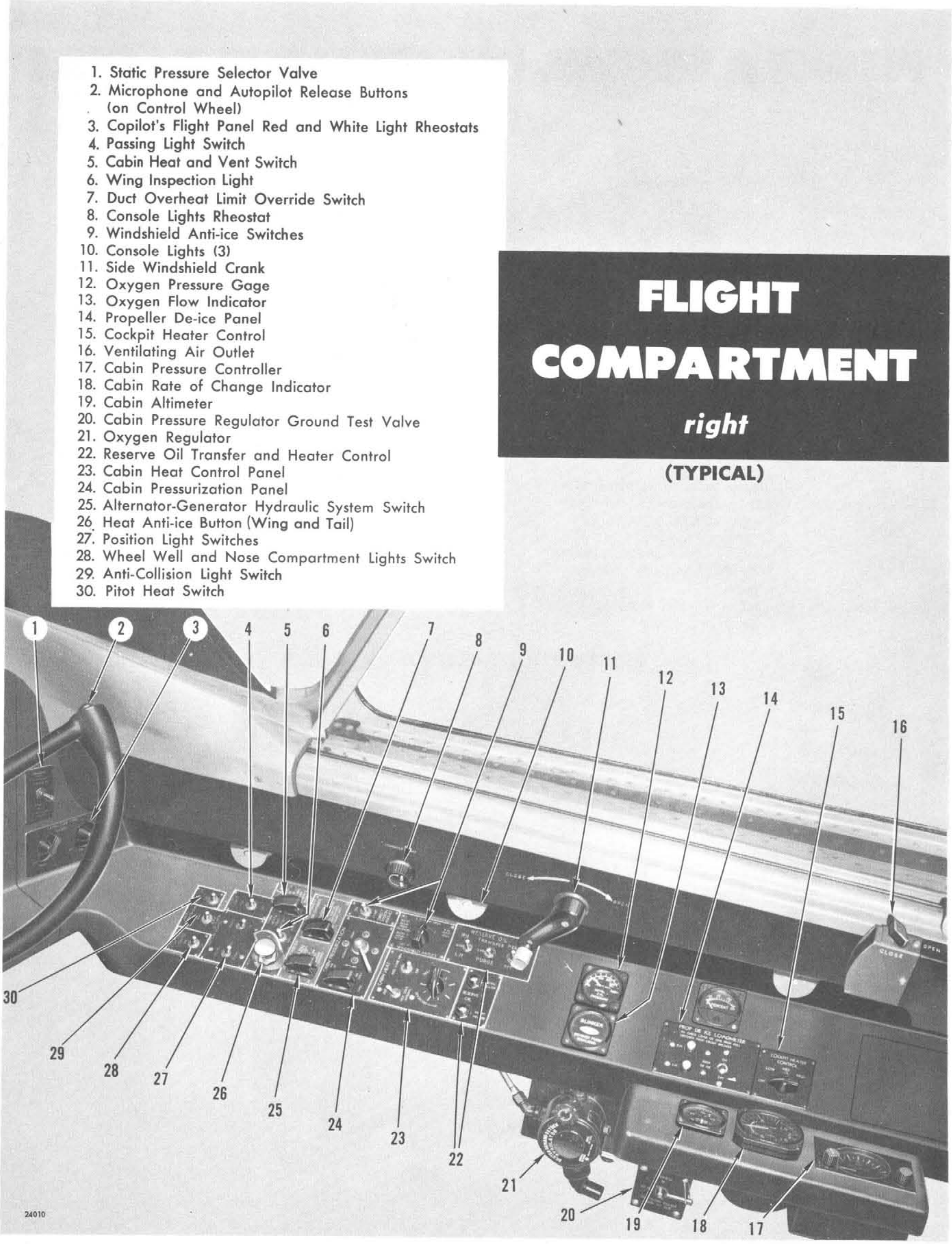
FLIGHT COMPARTMENT

left

(TYPICAL)

1. Ventilating Air Outlet
2. Console Lights (3)
3. Side Windshield Crank
4. Console Lights Rheostat
5. Windshield Wiper Control Knob
6. Direct Vision Windshield Locking Handle
7. Pilot's Flight Panel Red and White Light Rheostats
8. Static Pressure Selector Valve
9. Microphone and Autopilot Release Buttons (on Control Wheel)
10. Parking Brake Handle
11. Emergency Air Brake Knob
12. Nose Gear Steering Wheel
13. Passenger Warning Sign Switches
14. Landing Gear Warning Horn Switch
15. Oxygen Regulator
16. Oxygen Flow Indicator
17. Oxygen Pressure Gage
18. Landing Gear Uplatch Emergency Release Knob.

Figure 1-5



FLIGHT COMPARTMENT

right

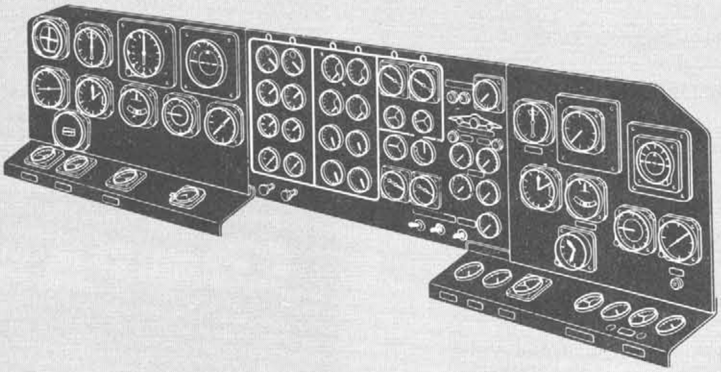
(TYPICAL)

1. Static Pressure Selector Valve
2. Microphone and Autopilot Release Buttons (on Control Wheel)
3. Copilot's Flight Panel Red and White Light Rheostats
4. Passing Light Switch
5. Cabin Heat and Vent Switch
6. Wing Inspection Light
7. Duct Overheat Limit Override Switch
8. Console Lights Rheostat
9. Windshield Anti-ice Switches
10. Console Lights (3)
11. Side Windshield Crank
12. Oxygen Pressure Gage
13. Oxygen Flow Indicator
14. Propeller De-ice Panel
15. Cockpit Heater Control
16. Ventilating Air Outlet
17. Cabin Pressure Controller
18. Cabin Rate of Change Indicator
19. Cabin Altimeter
20. Cabin Pressure Regulator Ground Test Valve
21. Oxygen Regulator
22. Reserve Oil Transfer and Heater Control
23. Cabin Heat Control Panel
24. Cabin Pressurization Panel
25. Alternator-Generator Hydraulic System Switch
26. Heat Anti-ice Button (Wing and Tail)
27. Position Light Switches
28. Wheel Well and Nose Compartment Lights Switch
29. Anti-Collision Light Switch
30. Pitot Heat Switch

Figure 1-6

FLIGHT & ENGINE INSTRUMENT PANELS

(TYPICAL)



1. Course Indicator (Omni and TACAN)
2. Marker Beacon Indicator Light
3. Airspeed Indicator
4. Directional Indicator
5. Attitude Indicator (Type MM-1)
6. Directional Indicator (Slaved)
7. Clock
8. Vertical Velocity Indicator
9. Turn and Slip Indicator
10. Tail Anti-Ice Temperature Gage
11. Right Wing Anti-ice Temperature Gage
12. Left Wing Anti-ice Temperature Gage
13. TACAN Range Indicator
14. Altimeter
15. Radio Magnetic Indicator

PILOT'S FLIGHT INSTRUMENT PANEL

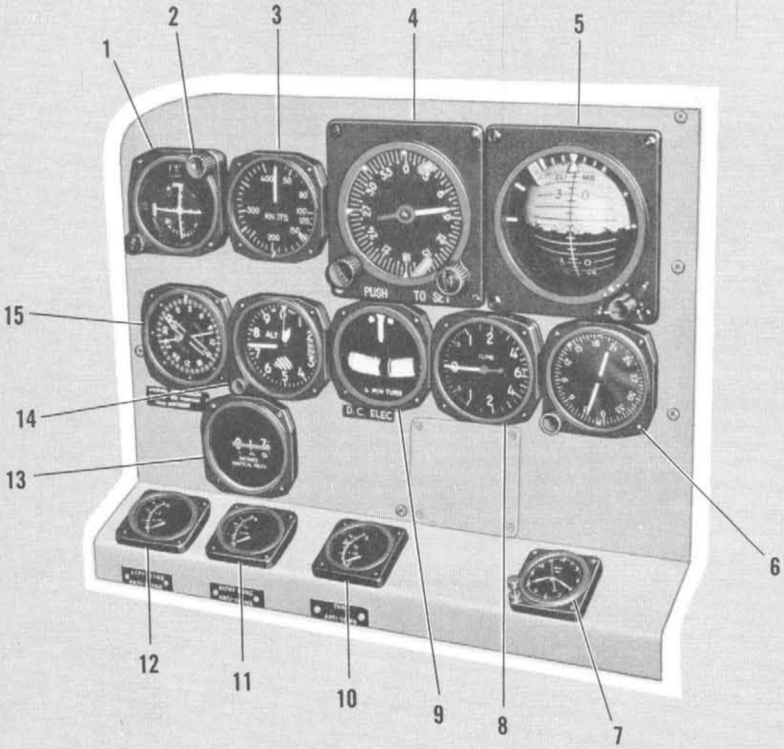


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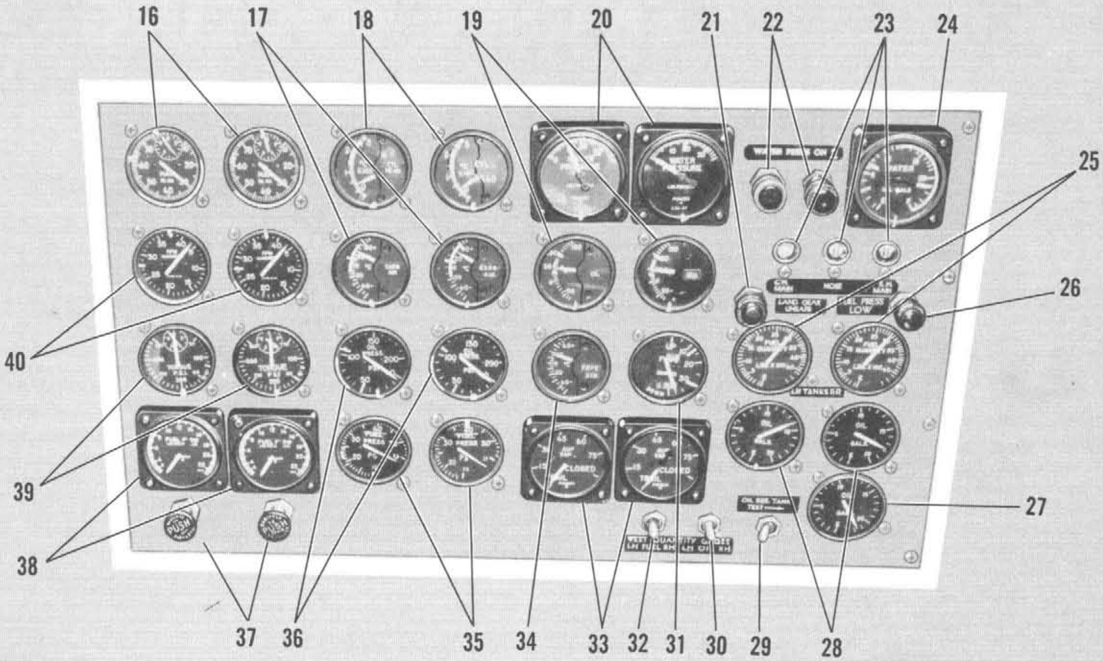
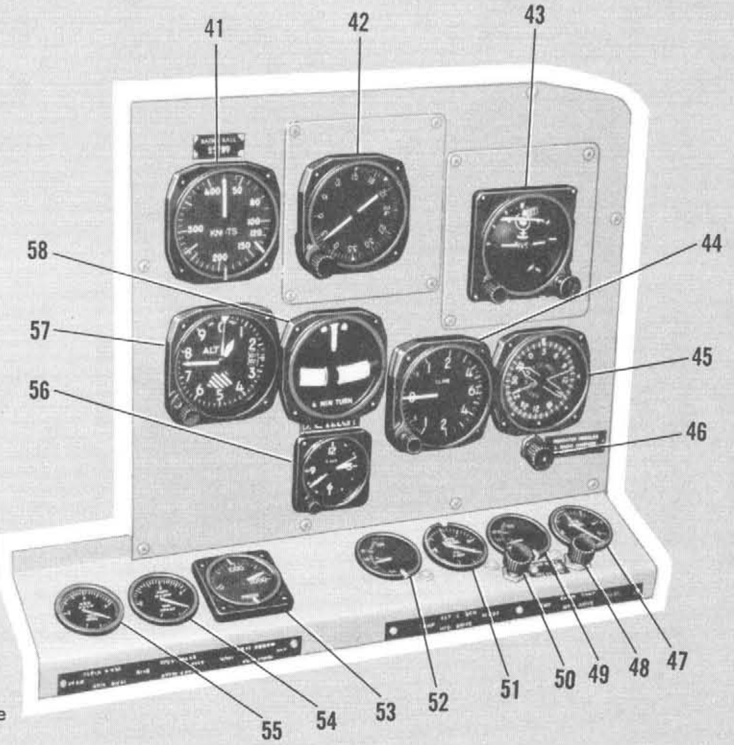
Figure 1-7

ENGINE INSTRUMENT PANEL



16. Manifold Pressure Gages
17. Carburetor Air Temperature Gages
18. Engine Cylinder Head Temperature Gages
19. Oil Temperature Gages
20. Water Pressure Gages
21. Landing Gear Unsafe Warning Light
22. Water Pressure ON Indicator Lights
23. Landing Gear Position Indicator
24. Water Quantity Gage
25. Fuel Quantity Gages
26. Fuel Pressure Low Warning Light
27. Reserve Oil Tank Quantity Gage
28. Engine Oil Tank Quantity Gages
29. Reserve Oil Tank Quantity Gage Test Switch
30. Engine Oil Tank Quantity Gages Test Switch
31. Wing Flap Position Indicator
32. Fuel Quantity Gages Test Switch
33. Augmentor Vane Position Indicators
34. Free Air Temperature Gage
35. Fuel Pressure Gages
36. Oil Pressure Gages
37. Manifold Pressure Gage Line Drain Valve Buttons
38. Fuel Flowmeters
39. Torquemeters
40. Tachometers
41. Airspeed Indicator
42. Directional Indicator (Slaved)
43. Attitude Indicator (Type J-8)
44. Vertical Velocity Indicator
45. Radio Magnetic Indicator
46. Marker Beacon Indicator Light
47. Cabin Compressor Hydraulic Pressure Gage
48. Cabin Compressor Hydraulic Pressure Low Warning Light
49. Cabin Compressor Hydraulic Temperature Gage
50. Alternator-Generator Hydraulic Pressure Low Warning Light
51. Alternator-Generator Hydraulic Pressure Gage
52. Alternator-Generator Hydraulic Temperature Gage
53. Emergency Air Brake Pressure Gage
54. Brake Hydraulic Pressure Gage
55. Main Hydraulic System Pressure Gage
56. Clock
57. Altimeter
58. Turn and Slip Indicator

CO-PILOT'S FLIGHT INSTRUMENT PANEL



24011-2

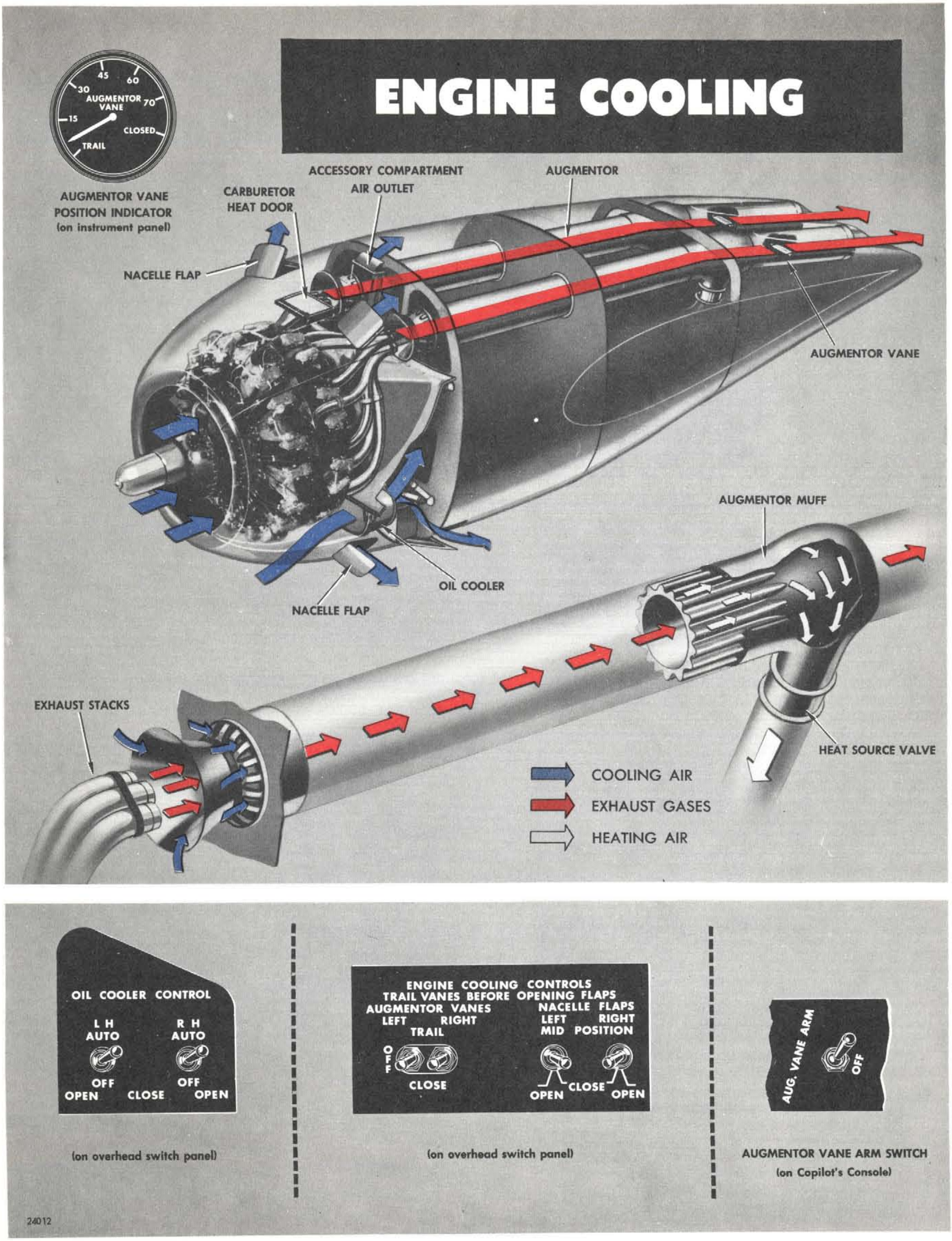

ENGINE COOLING
45
60
30
AUGMENTOR VANE
70
15
CLOSED
TRAIL
AUGMENTOR VANE POSITION INDICATOR (on instrument panel)
CARBURETOR HEAT DOOR
ACCESSORY COMPARTMENT AIR OUTLET
AUGMENTOR
NACELLE FLAP
AUGMENTOR VANE
AUGMENTOR MUFF
OIL COOLER
NACELLE FLAP
EXHAUST STACKS
HEAT SOURCE VALVE
COOLING AIR
EXHAUST GASES
HEATING AIR
OIL COOLER CONTROL
L H AUTO
R H AUTO
OFF
OFF
OPEN
CLOSE
OPEN
(on overhead switch panel)
ENGINE COOLING CONTROLS
TRAIL VANES BEFORE OPENING FLAPS
AUGMENTOR VANES
LEFT RIGHT
TRAIL
OFF
CLOSE
NACELLE FLAPS
LEFT RIGHT
MID POSITION
OPEN
CLOSE
OPEN
(on overhead switch panel)
AUG. VANE ARM
OFF
AUGMENTOR VANE ARM SWITCH (on Copilot's Console)
24012

Figure 1-8

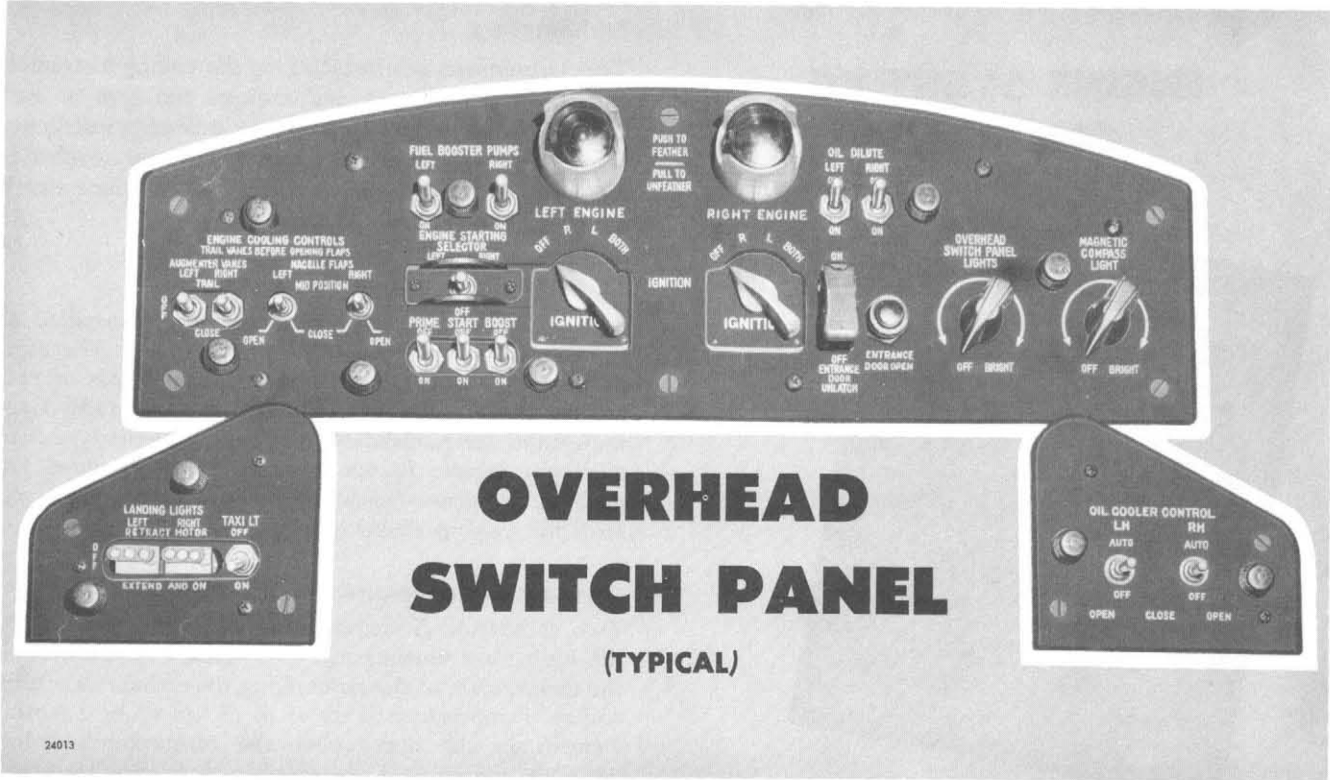


Figure 1-9

Engine Starting Selector Switch

The engine starting selector switch, located on the overhead switch panel (figures 1-9 and 1-10), is an open-guarded switch and has LEFT, RIGHT, and OFF positions. When an engine is to be started, placing the switch in either the LEFT or RIGHT position connects dc circuits from the ignition boost switch, prime switch, and start switch to the corresponding operating units at the engine. When these switches are held to ON for engine starting, dc power is then supplied to the operating units through the circuits previously closed by the engine starting selector switch.

Ignition Boost Switch

An ignition boost switch, located on the overhead switch panel (figure 1-9), has ON and OFF positions and is provided to afford a hot spark for engine starting. The switch is spring-loaded to the OFF position. As soon as the engine starts, magneto current is delivered to the spark plugs, and ignition boost current is no longer required. When held to ON, the switch supplies dc power to a vibrator that produces high-voltage current if the corresponding ignition switch is on. A circuit connects the vibrator to the ignition harness in each nacelle. Each circuit is kept open by a switch-operated relay. Only one of the relays operates at a time, depending on the position of the engine starting selector switch. Moreover, the appropriate relay closes the ignition boost circuit only while the engine start switch is held to ON. Thus ignition boost current is supplied to the nine front plugs in the front cylinder row of each engine only while the engine is being cranked by the starter.

Prime Switch

A two-position prime switch is located on the overhead switch panel (figure 1-9). The switch has ON and OFF positions and is spring-loaded to the OFF position. When held to ON during engine start, fuel is introduced directly into the engine blower case. The fuel booster pump for the engine being started must be operating in order to assure priming fuel flow. The position of the engine starting selector switch determines which engine will be primed. The prime switch closes a dc circuit to a solenoid-operated prime valve. The line from the valve bypasses the carburetor and leads directly from the fuel supply line to the throat of the engine blower.

Start Switch

The start switch (figure 1-10) located directly below the engine starting selector switch on the overhead switch panel, has ON and OFF positions and is spring-loaded to OFF. The position of the engine starting selector switch determines which engine starter will be energized when the start switch is held to ON. Operation of the start switch supplies dc power to the selected engine starter and also energizes the appropriate relay to close the ignition boost circuit from the ignition vibrator to the corresponding ignition harness.

ENGINE INDICATORS

Manifold Pressure Gages

Two direct-reading manifold gages, one for each engine, are located on the engine instrument panel (16, figure 1-7). The gages are calibrated in inches Hg in terms of

ENGINE STARTING CONTROLS

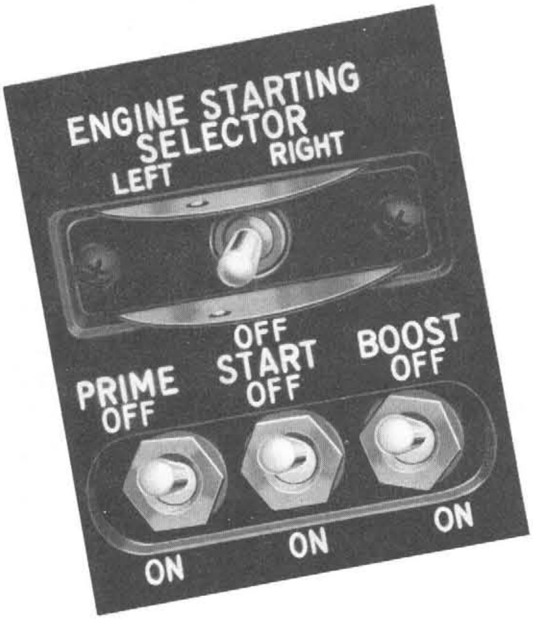


Figure 1-10

absolute pressure and measure the pressure in the induction mainifold of each engine. The manifold gages are used in conjunction with the tachometer as indicators of engine performance and power output. Direct pressure lines to the instrument are connected to the engine blower case. With the engines inoperative the gage readings should correspond to barometric pressure.

Manifold Pressure Gage Line Drain Valve Buttons

Two buttons (37, figure 1-7), located on the engine instrument panel, are provided to mechanically operate two valves for clearing foreign matter from the manifold pressure gage lines. Each valve is located in the line from each engine to the corresponding manifold pressure gage on the instrument panel. The buttons are depressed for a moment or two during engine warm-up with the manifold pressures several inches below field barometric pressure. This allows negative pressure in the manifold to pull foreign matter out of the gage lines into the engines, where it is discharged with the exhaust gases. If the buttons are pressed when manifold pressure equals barometric pressure, purging will not take place due to lack of suction. If the buttons are pressed inadvertently when manifold pressure exceeds barometric pressure, any foreign matter and fuel fumes in the lines will be blown into the flight compartment.

Tachometers

Two tachometers are installed on the engine instrument panel (40, figure 1-7) and indicate the rpm of each engine. The tachometer is a remote indicating instrument receiving power from a tachometer-generator attached to the engine accessory case, thereby operating independently of the airplane electrical systems.

Cylinder Head Temperature Gages

Two cylinder head temperature gages are installed on the engine instrument panel (18, figure 1-7). The gages indicate the temperature of the cylinder heads of each engine and are calibrated in degrees centigrade. Gage indications are received from a single bayonet-type thermocouple located in one cylinder of each engine. The gage is a self-generated electrical unit not requiring power from the airplane electrical system.

Carburetor Air Temperature Gages

Two carburetor air temperature gages are installed on the engine instrument panel (17, figure 1-7) and indicate the temperature of the air entering the carburetor of each engine. Temperature of the air is picked up by a sensing element in the duct above the carburetor coupling on each engine and is transmitted to the respective gage. The ratio-galvanometer-type gages are calibrated in degrees centigrade and operate on 28-volt dc power. Interruption of the current causes the pointer to fall below the low end of the scale.

Oil Temperature Gages

Two oil temperature gages, one for each engine, are installed on the engine instrument panel (19, figure 1-7), and indicate the temperature of oil entering each engine. The oil temperature gages are ratio-galvanometer-type units and operate on 28-volt dc power. If the voltage supply is turned off or fails, the pointer will swing below the low end of the indicator scale.

Oil Pressure Gages

Two oil pressure gages are installed on the instrument panel (36, figure 1-7) to indicate engine oil pressure in psi. The gages are remote indicating Autosyn-type units and operate from 26-volt regulated ac power. In the event of a power supply failure, the gages may remain within the normal operating range and can be expected to give false readings.

Fuel Pressure Gages

Two fuel pressure gages, one for each engine, are installed on the engine instrument panel (35, figure 1-7), and indicate engine fuel pressure in pounds per square inch. The gages are remote indicating Autosyn-type units and operate from 26-volt ac power. In the event of a power supply failure, the fuel pressure gages may remain within the normal operating range, thereby giving a false reading of fuel pressure.

Fuel Pressure-Low Warning Light

A red light (26, figure 1-7), located on the engine instrument panel, will illuminate if the fuel pressure of either engine drops below the minimum value. The light operates from the main dc bus.

Fuel Flowmeters

Two Magnesyn-type fuel flowmeters are installed on the engine instrument panel (38, figure 1-7) for each engine The flowmeter is a remote indicating unit having the transmitting unit installed in the fuel line between the carburetor and the blower case of each engine. All fuel consumed by the engine passes through the transmitter where the rate of flow is measured in pounds per hour. The fuel flowmeter units operate from 26-volt regulated ac power.

Torquemeters

Two torquemeters (39, figure 1-7), one for each engine, are located on the engine instrument panel and indicate the power being delivered to the propeller drive shaft. The system is essentially a method of measuring engine torque piston oil pressure and transmitting the pressure values to the indicators. The indication is in psi which refers to engine oil pressure built up in special torquemeter pressure pistons in the forward accessory section of the engine. The torquemeter transmitter is installed in the aft accessory section and is connected to the pressure pad on the front accessory case of each engine by a capillary pressure link. The transmitter and indicators are Autosyn-type remote indicating units and operate from a 26-volt regulated ac power supply.

Note

> Due to the larger accessory load carried by the right engine, torque indicated for the left engine will normally be higher than that indicated for the right engine when power settings are equal. This is because the torquemeter indicates only the power delivered to the propeller, not the total power developed by the engine.

PROPELLERS

Each engine is equipped with a three-blade, full-feathering, reversible pitch, Hamilton Standard hydromatic propeller. A propeller governor on each engine automatically adjusts propeller pitch to maintain constant engine speed under varying flight conditions. Governor settings are controlled from the flight compartment. Automatic and manual feathering controls are provided. Propeller pitch can be reversed on the ground to produce aerodynamic braking. Oil from the engine oil tank is used for propeller feathering and reversing. All propeller control electrical circuits are dc operated.

Propeller Speed Control Levers and Governor Limit Lights

Two propeller speed control levers (figure 1-13) are provided on the pedestal quadrant to increase or decrease engine and propeller rpm by changing the propeller blade pitch. Each lever has an INCREASE RPM (forward) position and a DECREASE RPM (aft) position. The levers are spring-loaded to an unmarked off position midway between the two operating positions. Propeller pitch change occurs at a rate that changes engine speed approximately 100 rpm per second, and reduction gearing keeps the propeller speed at 0.45 times engine speed. Low rpm and high rpm limit stops in the propeller governor limit the range of rpm change to predetermined settings. When either of the stops reaches the set limit, it also closes a dc circuit to the corresponding amber limit light on the pilots' pedestal. These propeller governor limit lights indicate that the high or low rpm limit has been reached. The light remains on as long as rpm is kept at either limit setting.

PROPELLER PITCH REVERSAL

When the airplane is on the ground, propeller pitch may be reversed by moving the corresponding throttle aft into the reverse thrust range. Solenoid-operated latch stops prevent moving the throttle into reverse thrust range when the airplane is airborne. Latch stops are also provided to prevent power application until the full reverse pitch setting of −25° is reached. Propeller pitch changes to full reverse at a rate of 14° per second. A limit stop in the pitch changing mechanism then actuates a blade switch which frees the throttle for further movement aft into the REVERSE OPEN position. As the throttles are moved forward again through the CLOSE detent, the propeller blades return to the positive pitch corresponding to the rpm setting of the governor.

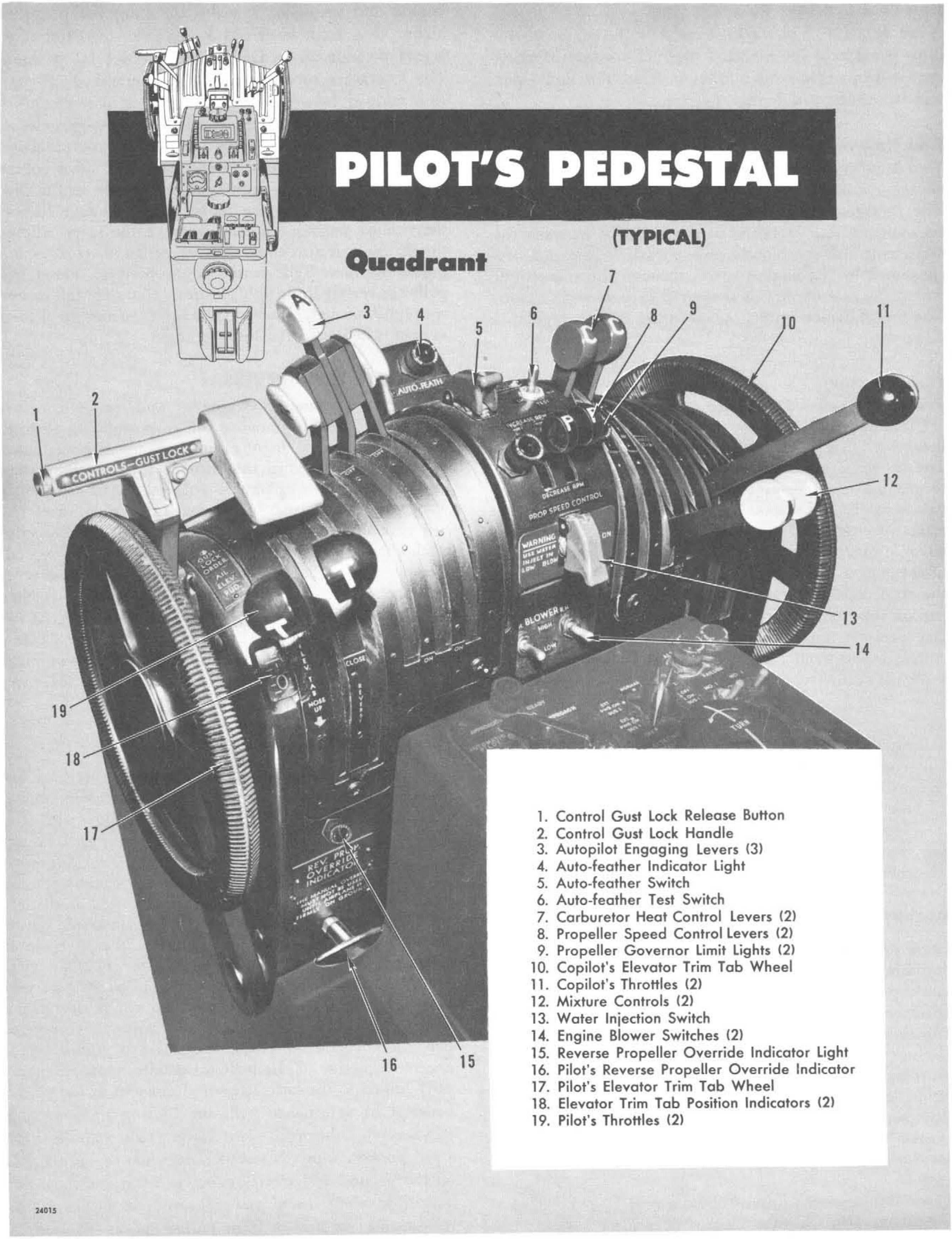
Reverse Propeller Latch Stops and Override Indicator Handles

Two latch stops, operated by one solenoid, are installed in the pedestal quadrant to prevent inadvertent movement of the throttles into reverse thrust range while the airplane is airborne. The stops for the two throttles operate in unison and are spring-loaded to the locking position. When the weight of the airplane compresses the main landing gear struts on landing, a switch on the left strut closes and energizes a relay that connects dc power to the solenoid, which then withdraws the latch stops. Refer to LANDING GEAR SAFETY CIRCUIT, Section VII. The throttles may then be pulled aft part way into the reverse thrust range, which closes dc circuits to the propeller pitch reversing mechanism. Two reverse propeller override indicator handles (16, figure 1-11), one on each side of the pedestal quadrant, are mechanically linked to the latch stops and move in or out of the pedestal in accordance with the locking or unlocking movement of the stops. The shafts of the handles have a red portion which is visible only when the airplane is on the ground and electrical power is on and must not be visible when the airplane is airborne. Either of the handles may be pushed in or pulled out, as required, to operate both latch stops to the desired position in event of failure of the solenoid to unlock the latches or of the

PILOT'S PEDESTAL

(TYPICAL)

Quadrant



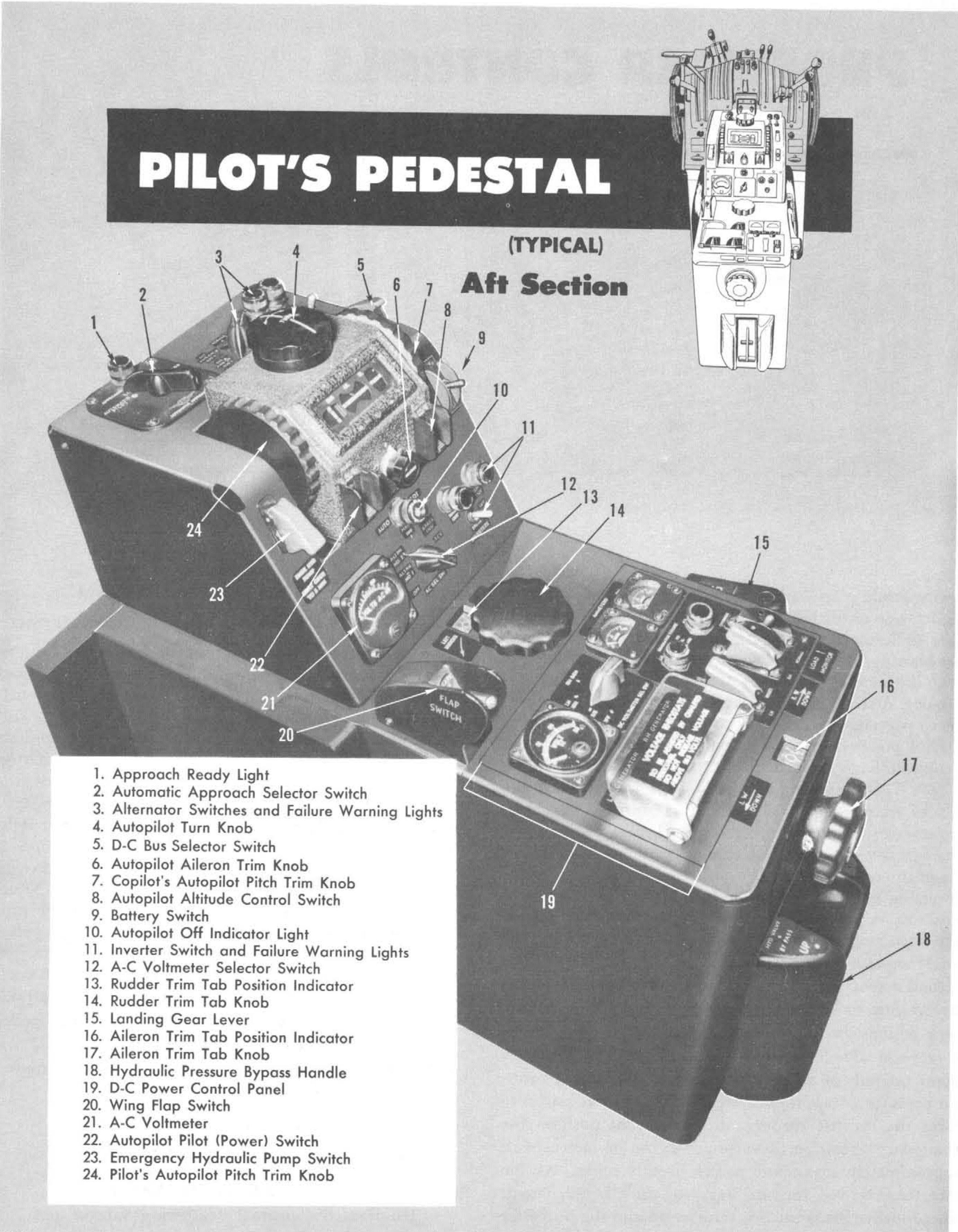
1. Control Gust Lock Release Button
2. Control Gust Lock Handle
3. Autopilot Engaging Levers (3)
4. Auto-feather Indicator Light
5. Auto-feather Switch
6. Auto-feather Test Switch
7. Carburetor Heat Control Levers (2)
8. Propeller Speed Control Levers (2)
9. Propeller Governor Limit Lights (2)
10. Copilot's Elevator Trim Tab Wheel
11. Copilot's Throttles (2)
12. Mixture Controls (2)
13. Water Injection Switch
14. Engine Blower Switches (2)
15. Reverse Propeller Override Indicator Light
16. Pilot's Reverse Propeller Override Indicator
17. Pilot's Elevator Trim Tab Wheel
18. Elevator Trim Tab Position Indicators (2)
19. Pilot's Throttles (2)

Figure 1-11

PILOT'S PEDESTAL

(TYPICAL)

Aft Section



1. Approach Ready Light
2. Automatic Approach Selector Switch
3. Alternator Switches and Failure Warning Lights
4. Autopilot Turn Knob
5. D-C Bus Selector Switch
6. Autopilot Aileron Trim Knob
7. Copilot's Autopilot Pitch Trim Knob
8. Autopilot Altitude Control Switch
9. Battery Switch
10. Autopilot Off Indicator Light
11. Inverter Switch and Failure Warning Lights
12. A-C Voltmeter Selector Switch
13. Rudder Trim Tab Position Indicator
14. Rudder Trim Tab Knob
15. Landing Gear Lever
16. Aileron Trim Tab Position Indicator
17. Aileron Trim Tab Knob
18. Hydraulic Pressure Bypass Handle
19. D-C Power Control Panel
20. Wing Flap Switch
21. A-C Voltmeter
22. Autopilot Pilot (Power) Switch
23. Emergency Hydraulic Pump Switch
24. Pilot's Autopilot Pitch Trim Knob

Figure 1-12

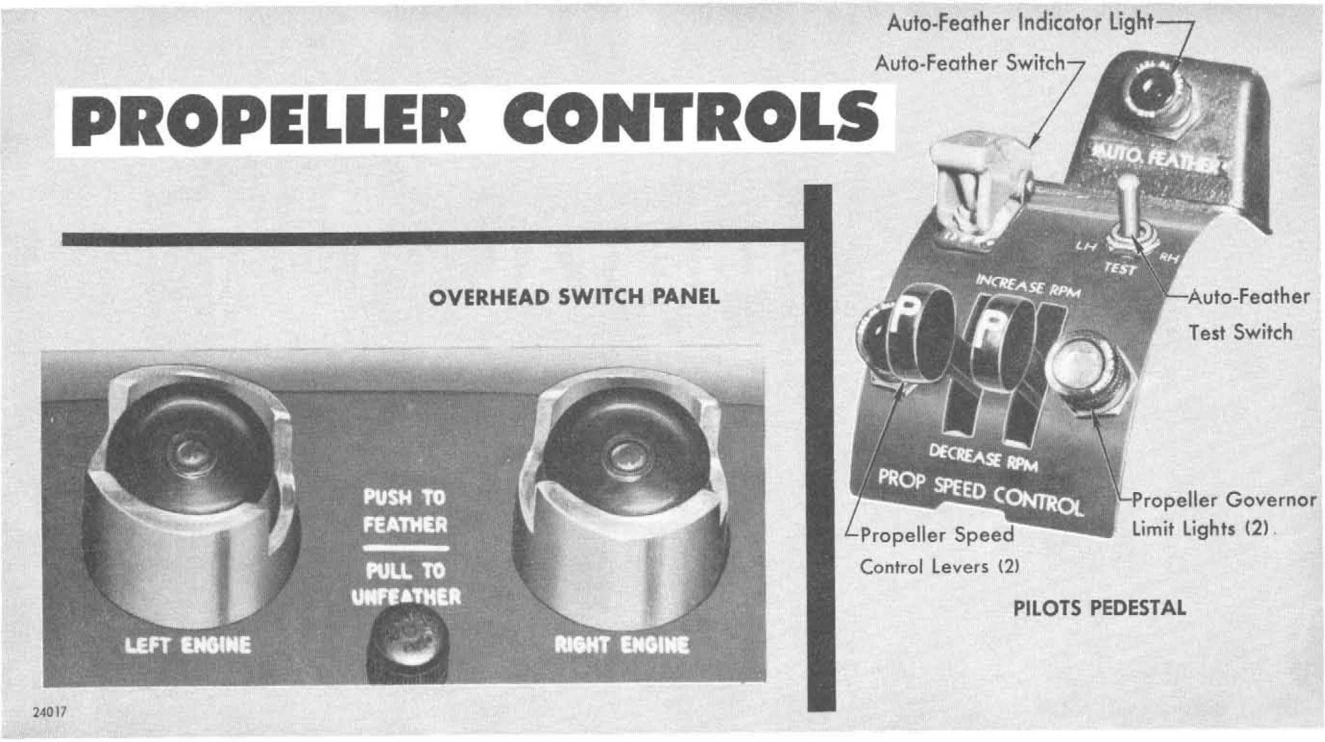


Figure 1-13

spring-loading to lock the latches. Two red indicator lights, one on each side of the pedestal above the override indicator handles, illuminate when the latch stops are starting to unlock. The lights operate in conjunction with the handles and will be illuminated when the handles are out. A secondary latch stop is provided at each throttle to prevent moving the throttle fully aft to REVERSE OPEN position before the blades of the corresponding propeller have reached the full reverse pitch setting of −25°. This prevents overspeeding the engine while the blades are passing through flat pitch during the change to reverse pitch. This secondary lock also prevents the inadvertent application of engine power with the throttle in the reverse range, if a malfunction of the propeller reversing system has left the blades in a positive thrust position. A solenoid energized by dc power withdraws the latch stop as soon as the propeller blade reaches the −25° reverse pitch limit. After the throttle is aft of the second detent, it requires approximately 21 pounds throttle pressure to increase reverse power and approximately nine pounds throttle pressure to decrease reverse power. A reverse aft detent limits normal reverse power to approximately 30 inches Hg. manifold pressure. A throttle pressure of approximately 28 pounds is required to force the throttle through this aft detent position for emergency operation. Reverse power can be increased to approximately maximum power in this range. As the throttle is moved forward again to the CLOSE detent, the propeller blade pitch is unreversed and the propeller returns to a positive pitch setting. The blade limit switch then opens the circuit to the solenoid and the latch stops again prevent full reverse thrust movement of the throttle.

PROPELLER MANUAL FEATHERING SYSTEM

Manual Feathering Buttons and Indicator Lights

Two red, push-pull type, manual feathering buttons (figure 1-13) are provided on the overhead switch panel for manual feathering and unfeathering of the propellers. The buttons are placarded "Push to Feather – Pull to Unfeather." Each button has three unmarked positions – IN, OUT, and NORMAL (half out). When a button is pushed to IN, the corresponding feathering pump is started, and a holding circuit holds the button in until the feathering action is completed. A red indicator light in the bottom illuminates to indicate that the propeller is feathering. After feathering has started, the feathering cycle can be stopped by pulling the button to the NORMAL position. If this is done in flight before the propeller has feathered and stopped rotating, the propeller blades will return to the pitch corresponding to the rpm setting of the governor. After a propeller has been completely feathered, unfeathering is accomplished by pulling the manual feathering button to OUT until propeller rotation begins, then releasing the buttton to NORMAL position. The blades then return to the pitch required to attain the rpm setting of the governor.

WARNING

Holding the manual feathering button out longer than necessary to unfeather may cause inadvertent pitch reversal if the electrical circuit is inoperative or defective.

Before unfeathering, the governor should be set to its decrease rpm (high pitch) limit by operation of the propeller speed lever. This prevents engine overspeed in the event of a power surge when the engine is started. All propeller control circuits and indicator circuits are dc powered.

PROPELLER AUTOFEATHERING SYSTEM

The autofeathering system (figure 1-14) is provided to automatically feather a propeller in the event of engine failure during takeoff. When turned on (armed) the autofeathering system will automatically feather the corresponding propeller if the throttle has been advanced to a position equivalent to 45 inches Hg. (sea level) and the torque pressure drops below 40 (±5) psi for two to three seconds. (The time delay prevents autofeathering during momentary power lags.) The system will not autofeather the second propeller if one propeller has already feathered either automatically or manually provided the autofeathering system is not rearmed. The system receives dc power through the autofeather switch, a torque pressure switch at each engine, and microswitches in the pedestal.

Note

> The autofeather switch will normally be on for takeoff and the propeller of the failed engine will automatically feather. This will be indicated when the light in the propeller manual feathering button of the failed engine comes on and two seconds later the manual feathering button automatically moves into the feather position.The red light in the manual feather button will stay on until the propeller is feathered and the button pops out. The green autofeather indicator on the pedestal will go out on completion of the autofeathering cycle.

Autofeather Switch and Indicator Light

A guarded ON-OFF autofeather switch, located on top of the pilot's pedestal quadrant (5, figure 1-11, and figure 1-13), controls dc power to arm the autofeather circuits. With the autofeather switch in the ON position, operation of the system is automatic. A green indicator light (4, figure 1-11), illuminates when dc power is connected to the autofeathering system. The light illuminates when the switch is turned on and goes out when the switch is turned off. The light will also go out if either propeller is automatically or manually feathered while the autofeather switch is in the ON position.

Autofeather Test Switch

A test switch (6, figure 1-11), located on the top of the pilot's pedestal quadrant, allows ground testing of the autofeathering system. The test switch has LH and RH positions and is spring-loaded to an unmarked OFF position. When the autofeathering system is armed, holding the test switch to either LH or RH position closes a dc circuit bypassing the corresponding throttle-operated microswitch in the autofeather circuits. The corresponding manual feather button will be drawn in and the

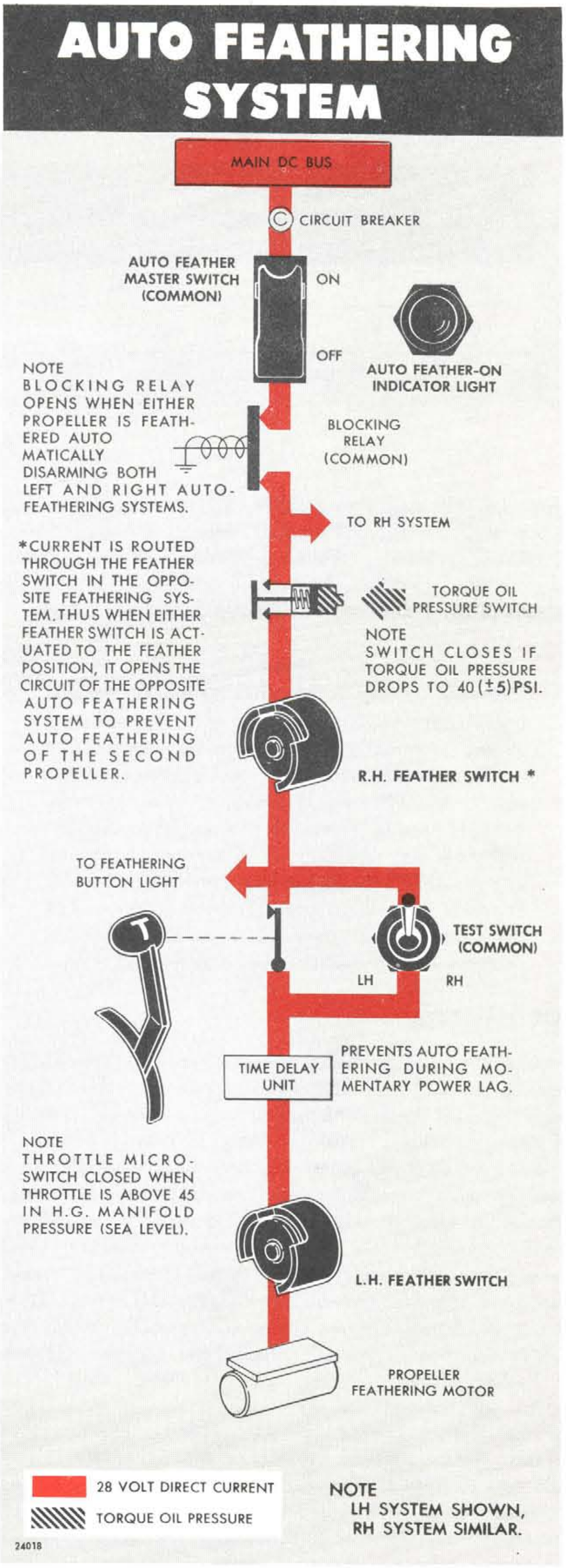

AUTO FEATHERING SYSTEM
MAIN DC BUS
CIRCUIT BREAKER
AUTO FEATHER MASTER SWITCH (COMMON)
ON
OFF
AUTO FEATHER-ON INDICATOR LIGHT
NOTE BLOCKING RELAY OPENS WHEN EITHER PROPELLER IS FEATHERED AUTOMATICALLY DISARMING BOTH LEFT AND RIGHT AUTOFEATHERING SYSTEMS.
BLOCKING RELAY (COMMON)
TO RH SYSTEM
*CURRENT IS ROUTED THROUGH THE FEATHER SWITCH IN THE OPPOSITE FEATHERING SYSTEM.THUS WHEN EITHER FEATHER SWITCH IS ACTUATED TO THE FEATHER POSITION, IT OPENS THE CIRCUIT OF THE OPPOSITE AUTO FEATHERING SYSTEM TO PREVENT AUTO FEATHERING OF THE SECOND PROPELLER.
TORQUE OIL PRESSURE SWITCH
NOTE SWITCH CLOSES IF TORQUE OIL PRESSURE DROPS TO 40(±5)PSI.
R.H. FEATHER SWITCH *
TO FEATHERING BUTTON LIGHT
T
TEST SWITCH (COMMON)
LH
RH
PREVENTS AUTO FEATHERING DURING MOMENTARY POWER LAG.
TIME DELAY UNIT
NOTE THROTTLE MICROSWITCH CLOSED WHEN THROTTLE IS ABOVE 45 IN H.G. MANIFOLD PRESSURE (SEA LEVEL).
L.H. FEATHER SWITCH
PROPELLER FEATHERING MOTOR
🟥 28 VOLT DIRECT CURRENT
▨ TORQUE OIL PRESSURE
NOTE LH SYSTEM SHOWN, RH SYSTEM SIMILAR.
24018

Figure 1-14

OIL QUANTITY DATA TABLE

TANK	NUMBER OF TANKS	USABLE OIL (EACH TANK)	RESERVE OIL FOR FEATHERING (EACH TANK)	UNUSABLE OIL	EXPANSION SPACE (EACH TANK)	TOTAL VOLUME (EACH TANK)
ENGINE	2	20 GAL.	2 GAL.	—	5 GAL.	27 GAL.
RESERVE	1	22 GAL.	—	1.5 GAL.	4.5 GAL.	28 GAL.

24275

Figure 1-15

propeller will begin to feather. To stop the feathering action, pull the affected manual feathering button out to NORMAL and the propeller will return to the rpm setting of the governor. The autofeather switch must be turned to OFF and back to ON to rearm the system.

Note

> The test of the autofeathering system is not completed until it is observed that the red lights in the two manual feathering buttons go out as the throttles are advanced beyond approximately 25 inches Hg manifold pressure position (45 psi torque pressure). As the throttles are retarded the lights will come on again at approximately 20 inches Hg manifold pressure. If either or both of the lights fail to go out as the throttles are advanced, autofeather torque pressure switch malfunction is indicated.

OIL SYSTEM

Each engine has an independent oil system that incorporates an oil tank and an oil cooler in the nacelle (figure 1-16). Each tank has a total usable oil capacity of approximately 22 gallons. Only 20 gallons are available for use by the engines: the remaining two gallons are reserved by a short standpipe for propeller feathering. See the Oil Quantity Data Table, figure 1-15. Oil cooling air is obtained from a flush air scoop in the bottom cowl panel. An automatically operated, full closing, oil cooler flap, with selective override electrical control, is located at the oil cooling air exit slot in each nacelle. When the flap is open, air is routed through the cooling coil and is discharged out the flap opening. When the flap is closed, air leaving the oil cooler scoops is discharged through the accessory compartment air outlet. A reserve oil tank, having a usable capacity of approximately 22 gallons and equipped with heaters and a transfer pump, is installed below the forward lavatory floor. Transfer lines run from the reserve oil tank through a selector valve to the engine oil tank in each nacelle. The transfer pump and the selector valve are operated by power from the main dc bus. See figure 1-40 for oil grade and specification.

OIL SYSTEM CONTROLS AND INDICATORS

Oil Cooler Switches

Two four-position oil cooler switches (figure 1-9) are provided to the right of the overhead switch panel. Switch positions are AUTO, OFF, OPEN, and CLOSE. In respect to OPEN and CLOSE, the switches are spring-loaded to OFF. Each switch, when in AUTO position, routes dc power to a thermostat in the oil return line at the engine oil tank in the corresponding nacelle. The thermostat is adjusted so that in event oil temperature falls below or rises above preset limits it will route power to the closing or opening side of the oil cooler flap actuating motor. If the thermostat fails to monitor oil temperature as required, the appropriate oil cooler control switch must be moved to OFF and then held to OPEN or CLOSE position, as necessary. When oil temperature again appears to be normal the switch can be returned to AUTO position. If the switch is left in OFF position, the oil cooler flap will remain in the position to which it was last operated. Position indicators are not provided.

Reserve Oil Controls

A function selector switch and a reserve oil control switch (figure 1-16), located on the copilot's console, are provided to transfer reserve oil to the engine oil tanks and to purge the transfer lines after transfer. The function selector switch has three positions: TRANSFER, OFF, and PURGE. The reserve oil control switch has LH, OFF, and RH positions and is spring-loaded to the OFF position. When the function selector switch is placed in the TRANSFER position and the reserve oil control switch is held in either the LH or RH position, dc power is routed to the transfer selector valve to open the line to the selected engine oil tank. After the valve has completed its travel the transfer pump will start and reserve oil will be transferred to the selected oil tank. When the control switch is released to the OFF position, the pump will stop and the transfer selector valve will return to its closed position. Overfilling of an engine oil tank is prevented by a dc powered automatic cutoff switch which stops the transfer pump when the oil quantity gage reaches 20 gallons. When the function switch is placed in the PURGE position, and the reserve oil control switch is held in either the LH or RH position, the transfer pump will run in reverse to purge the transfer line and, at the same time, fuel will enter the line through a solenoid-operated valve. This keeps the oil remaining in the line to a minimum and the oil is diluted to prevent congealing, thus assuring effective oil transfer during cold weather operations.

Reserve Oil Heat Switch and Heater Indicator Lights

A reserve oil heater switch and two reserve oil heater indicator lights (figure 1-17) are mounted on the copilot's console. Switch positions are HEAT and OFF. The indicator lights are placarded "Initial Heater" and "Maint Heater" and are dc operated. When in HEAT position, the switch directs 115-volt unregulated ac power from bus No. 1 to the initial heater and the maintenance heater. The lights illuminate only when the heater switch is in the HEAT position. If oil near the wall of the tank is heated to 68°C (155°F) the heaters will be deenergized until the boundary oil cools below that temperature, at which time the maintenance heater will again operate. Cycling in this manner will continue as long as the switch is in HEAT position. If oil in the center of the tank reaches a temperature above 21°C (70°F) the initial heater will be permanently shut off. It can be reactivated only by turning the switch to OFF and then turning it again to HEAT. The maintenance heater will continue to operate and cycle as before. Refer to Section VII, OIL SYSTEM, for additional information.

Note

> When the propeller de-icing system is operating, a timer monitors power alternately to the reserve oil heaters and to the propellers. Thus the oil heaters operate only during the off cycle of the propeller de-icing system.

The reserve oil heat switch must be placed in HEAT position whenever the free air temperature is 21°C (70°F) or below if oil transfer is anticipated. Bus No. 1 supplies unregulated ac power for the oil heaters.

Oil Dilute Switches

Oil dilution valves in the nacelles are controlled by two oil dilute switches on the overhead switch panel (figure 1-9). The switch positions are OFF and ON. They are spring-loaded to OFF. When held to ON position, the switches connect dc power to solenoid-operated valves in the oil dilution lines. For oil dilution management, refer to Section IX.

Engine Fluid-Off Handles

An oil shutoff valve is installed in each engine oil supply line at the firewall. These valves are mechanically operated by the engine fluid-off handles (figure 1-37) on the fire control panel. Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.

Oil Quantity Gages

An oil quantity gage (27, 28, figure 1-7) is provided for each of the three oil tanks. The gages read in U.S. gallons. They are operated by 115-volt regulated ac power.

CAUTION

> If the electrical circuit to one of these gages fails, the gage continues to register the quantity indicated at the time of failure.

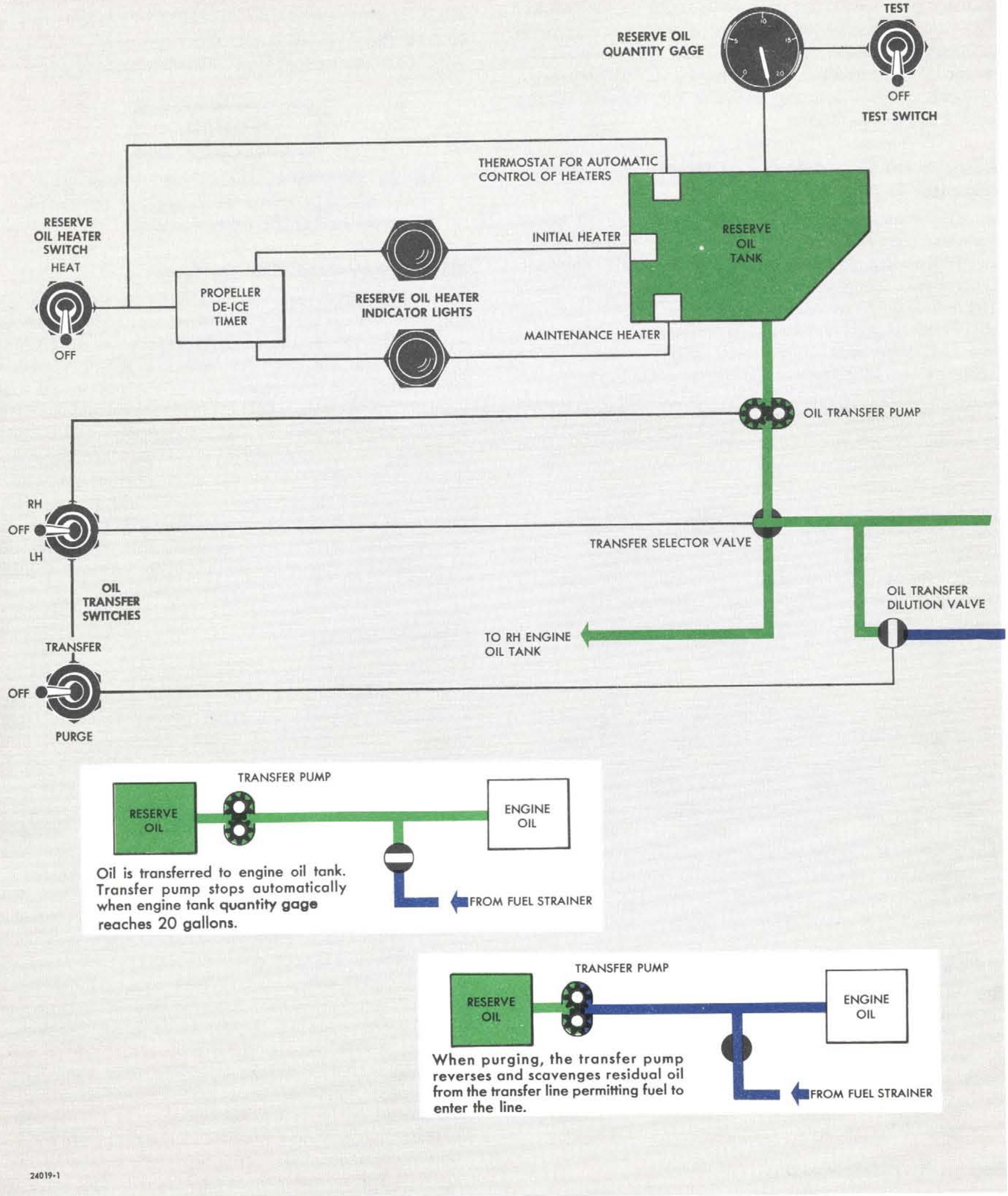
Oil Quantity Gage Test Switches

Two oil quantity gage test switches (29, 30, figure 1-7) are provided on the engine instrument panel. One test switch is for the engine oil tank quantity gages; test positions are LH and RH. The switch is spring-loaded to OFF. The other test switch is for the reserve oil tank quantity gage; it has OFF and TEST positions and is spring-loaded to OFF. If a gage is functioning, its needle will move to the low end of the scale when the corresponding test switch is held to a test position and return to its original position upon release of the switch. If the gage is not functioning, the needle will remain in the same position when tested, or will move to the low end of the scale and will not return to its original position upon release of the test switch.

FUEL SYSTEM

The fuel system (figure 1-18) is comprised of two independent integral fuel systems, one for each engine, with a crossfeed line which may be opened to allow either engine to be supplied by the opposite tank, or both engines to be supplied by either tank. Each side of the wing has two interconnected fuel-tight compartments which serve as fuel tanks. See figure 1-20 for fuel quantity. The compartments in one wing are not connected with the compartments in the other wing. A line leads forward to an electrically operated fuel booster pump in each nacelle. A crossfeed line, fitted with two valves operated mechanically and simultaneously by a crossfeed handle on the fuel control panel, crosses from one nacelle to the other and interconnects the two fuel lines forward of the booster pumps. The booster pump on either side is thus able to help feed fuel to the opposite engine during crossfeed operation, as well as to its own engine, as required. An electrically operated main fuel shutoff valve is installed in each nacelle upstream from the booster pump. Each engine has an engine-driven fuel pump. A fuel shutoff valve, operated mechanically by the corresponding engine fluid-off valve control on the fire control panel, is installed at the firewall in each nacelle. Branch lines to the oil dilute valve and oil transfer fuel valve are provided in each nacelle. A fuel quantity gage for each tank, a fuel flowmeter, and a fuel pressure gage for each engine are provided on the engine instrument panel.

OIL SYSTEM / reserve

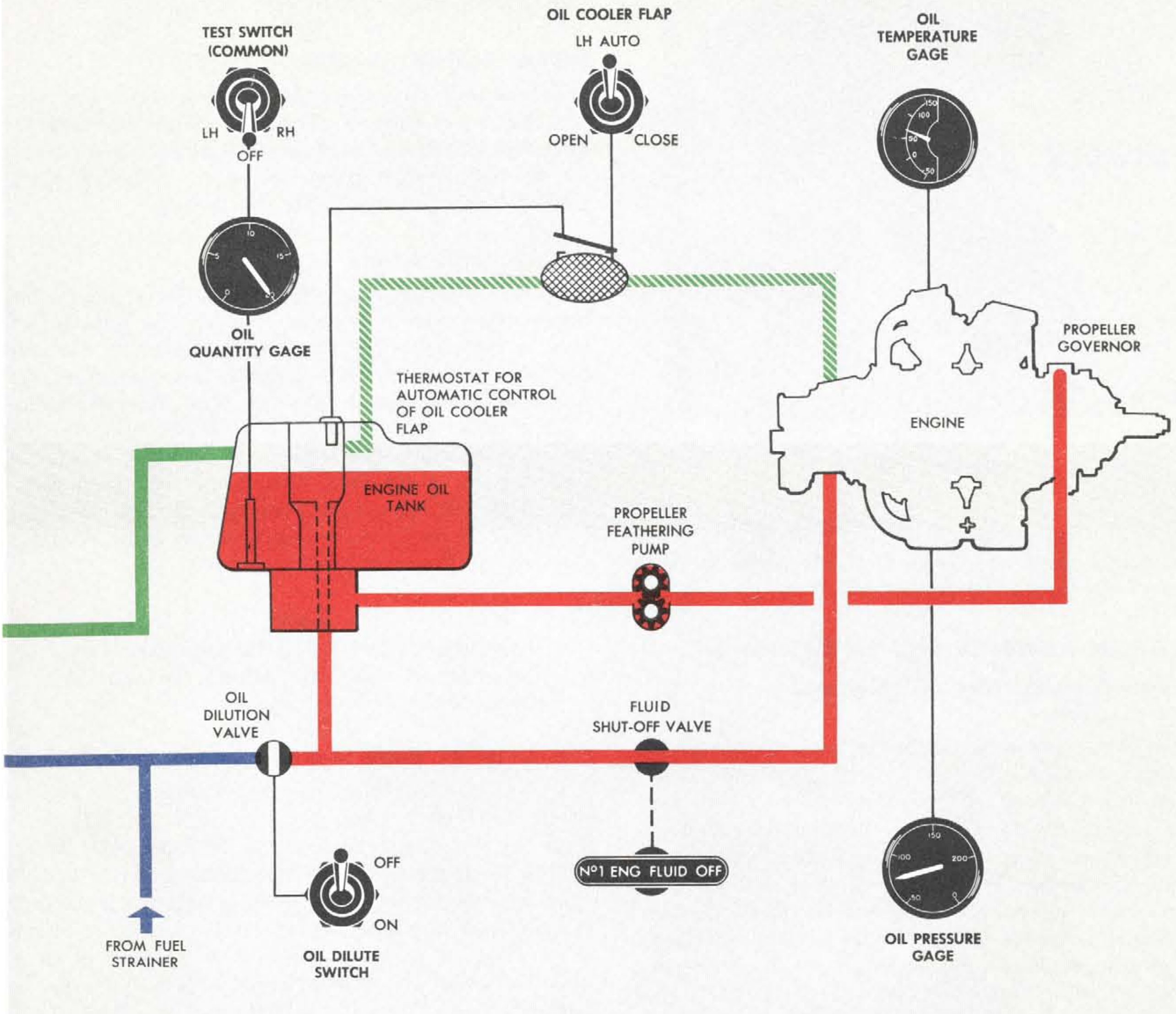


Oil is transferred to engine oil tank. Transfer pump stops automatically when engine tank quantity gage reaches 20 gallons.

When purging, the transfer pump reverses and scavenges residual oil from the transfer line permitting fuel to enter the line.

Figure 1-16

OIL SYSTEM / main



CODE

- 🟥 ENGINE OIL SUPPLY
- ▨ ENGINE OIL RETURN
- 🟩 RESERVE OIL SUPPLY
- 🟦 FUEL LINE
- —— ELECTRICAL ACTUATION
- – – – MECHANICAL ACTUATION

NOTE:
LH system shown
RH similar.

24019-2

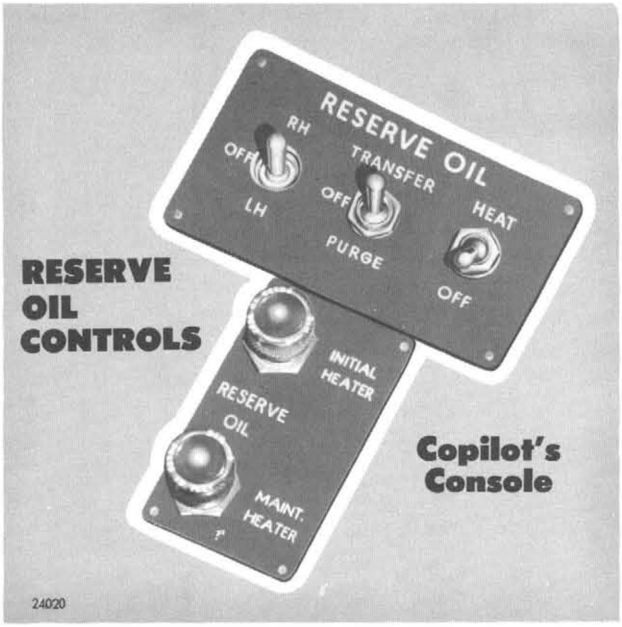


Figure 1-17

A fuel quantity gage test switch and a fuel pressure-low warning light serve both sides of the fuel system. See figure 1-40 for fuel grade and specification.

FUEL SYSTEM CONTROLS AND INDICATORS

Main Fuel Shutoff Valve Switches and Indicator Lights

Two switches, one for each main fuel tank shutoff valve, are located on the fuel control panel (figure 1-19). The switches have ON and OFF positions. When a switch is placed in the ON position, the corresponding shutoff valve will open. When the switch is placed in the OFF position, the corresponding valve will close. A fuel valve indicator light adjacent to each switch will illuminate continuously when the corresponding valve is traveling to either of its extreme limits. The light will go out when the valve has reached its fully open or fully closed position, indicating successful operation of the valve. A light which remains on indicates that the corresponding valve has stopped in an intermediate position between open and close. When both lights are out, the specific position of the fuel shutoff valves is indicated by the position of the corresponding switches only. The valves and lights operate on power from the main dc bus.

Fuel Booster Pumps and Switches

A fuel booster pump is installed in the main fuel line in each nacelle upstream from the crossfeed line connection. The pumps are dc operated and are turned on and off by the fuel booster pump switches (figure 1-9). Fuel booster pump power is sufficient to provide normal fuel pressure at the carburetors indefinitely, in event of failure of an engine-driven fuel pump. Refer to BOOSTER PUMP OPERATION, Section VII.

Fuel Crossfeed Handle

A crossfeed handle (figure 1-19) on the fuel control panel mechanically opens and closes both fuel crossfeed valves. Turning the handle 90° clockwise opens the valves. Turning the handle counterclockwise to the vertical position closes the valves.

Engine Fluid-Off Handles

A fuel shutoff valve is installed in each engine fuel supply line at the firewall. These valves are mechanically operated by the engine fluid-off handles (figure 1-37) on the fire control panel. Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.

Fuel Quantity Gages

Two fuel quantity gages (25, figure 1-7) on the engine instrument panel indicate in pounds the quantity of fuel in the tanks. The gages are operated by 115-volt regulated ac power. Fuel quantity is sensed at several points in each tank and these signals are balanced before transmittal to the quantity gages, so that accurate fuel quantity indications by weight are provided regardless of changes of temperature, density, and airplane attitude. The gages will indicate less fuel than actual gallonage on a hot day inasmuch as gallonage weight is less on a hot day than on a standard day.

Note

> If the power circuit to one of these gages fails, the gage continues to indicate the quantity shown at the time of failure.

Fuel Quantity Gage Test Switch

A fuel quantity gage test switch (32, figure 1-7) on the engine instrument panel has LH, OFF, and RH positions and is spring-loaded to the OFF position. When held in either the LH or the RH position, 115-volt regulated ac power to the corresponding gage is unbalanced. If the system is functioning, the needle will move to the low end of the scale and return to its original position upon release of the switch. If the system is faulty, the gage needle will move to the low end of the scale, but will not return to its original position when the test switch is released.

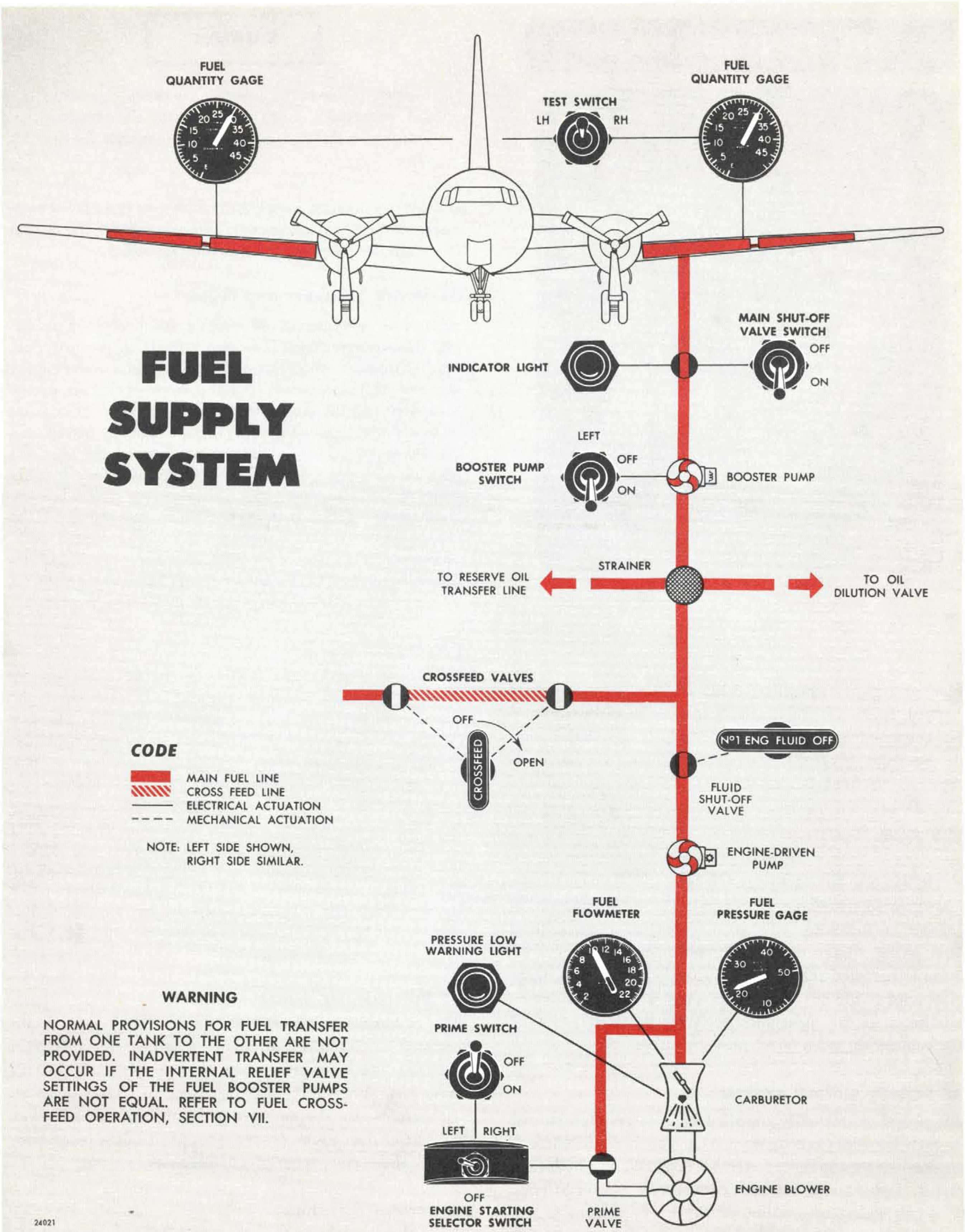
ELECTRICAL POWER SUPPLY SYSTEMS

Direct Current

Direct current (24 to 28-volt) is required to operate lights, motors, actuators, solenoids, propeller governors, fire detection and extinguisher components, and other items of electrical equipment; it is supplied to a main bus, a nonessential equipment bus, and an emergency bus, by two generators, two batteries, or an external dc power source.

Regulated Alternating Current

Regulated (constant frequency), 115-volt alternating current is required to operate the flight instruments (except



CODE

🟥 MAIN FUEL LINE
▨ CROSS FEED LINE
—— ELECTRICAL ACTUATION
- - - - MECHANICAL ACTUATION

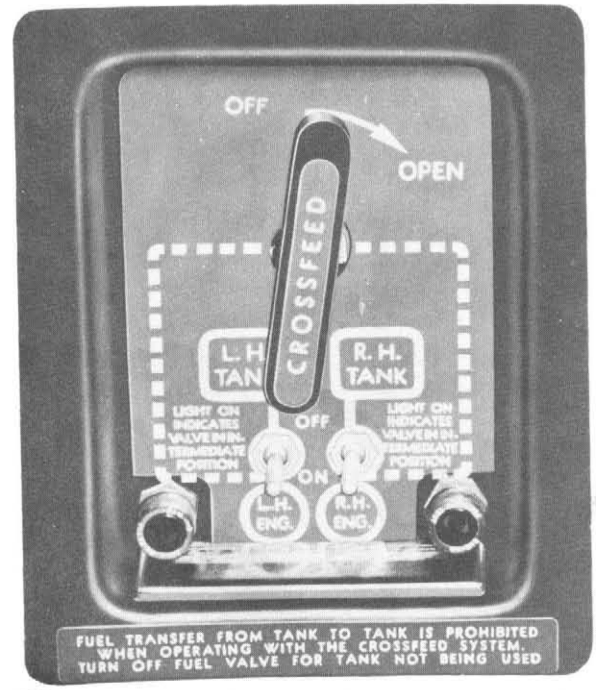
NOTE: LEFT SIDE SHOWN, RIGHT SIDE SIMILAR.

WARNING

NORMAL PROVISIONS FOR FUEL TRANSFER FROM ONE TANK TO THE OTHER ARE NOT PROVIDED. INADVERTENT TRANSFER MAY OCCUR IF THE INTERNAL RELIEF VALVE SETTINGS OF THE FUEL BOOSTER PUMPS ARE NOT EQUAL. REFER TO FUEL CROSS-FEED OPERATION, SECTION VII.

Figure 1-18

FUEL CONTROL PANEL


OFF
OPEN
CROSSFEED
L.H. TANK
R.H. TANK
LIGHT ON INDICATES VALVE IN INTERMEDIATE POSITION
LIGHT ON INDICATES VALVE IN INTERMEDIATE POSITION
OFF
ON
L.H. ENG.
R.H. ENG.
FUEL TRANSFER FROM TANK TO TANK IS PROHIBITED WHEN OPERATING WITH THE CROSSFEED SYSTEM. TURN OFF FUEL VALVE FOR TANK NOT BEING USED

24022

Figure 1-19

turn and slip), autopilot, cabin automatic temperature control, fuel and oil quantity gages, radar altimeter, and HF communication equipment. Power is supplied by two dc powered inverters. Regulated 26-volt ac power is required to operate pressure gages, torquemeters, and augmentor vane position indicators. Power is supplied through an inverter powered transformer.

Unregulated Alternating Current

Unregulated (variable frequency), 115-volt alternating current required for reserve oil heat, de-icing, cockpit heat, galley, glide-slope, Tacan, and radar altimeter operation is supplied through two buses by an engine-driven alternator in the left nacelle and a hydraulic motor-driven alternator in the right nacelle. A receptacle is provided for connecting external ac power sources.

DC POWER SUPPLY SYSTEM

DC power is normally supplied by two generators, one in each nacelle. (See figure 1-21.) The left generator is engine-driven; the right generator is driven by a hydraulic motor. Two 12-volt batteries connected in series provide a 24-volt source of standby dc power. A receptacle forward of the main entrance door is provided for connecting external dc power. See figure 1-21 for dc operated equipment.

CAUTION

> When using battery power to check operation of equipment, limit operation to the absolute minimum because of the small capacity of the batteries.

A load monitoring circuit is provided to disconnect nonessential electrical equipment automatically if the output of either generator fails or is interrupted.

DC Circuit Breakers and Fuses

With four exceptions, dc circuits are protected by circuit breakers or fuses. The two circuits to the propeller feathering pump motors and the two circuits to the engine starters are unprotected. All the circuit breakers except propeller control are of the trip-free type which cannot be overridden against a fault. Circuit breakers are located on the main circuit breaker panel behind the copilot's seat, on the emergency and nonessential circuit breaker panel behind the pilot's seat, the generator circuit breaker panel in the forward belly compartment, and the radio power circuit breaker panel on the radio equipment rack. (See figure 1-22 for circuit breaker panel locations.) Two circuit breakers (14, figure 1-6), on the copilot's console, protect the individual propeller de-ice control circuits.

Battery Switch

A side-guarded battery switch (9, figure 1-12) on the pilot's pedestal is used to connect and disconnect the batteries to the main and emergency dc buses. The battery switch has BAT and OFF positions. A minimum battery voltage of approximately 18 volts is required to close the battery relay connecting the battery to the bus. This relay must be closed before the generators can recharge the battery, and a check should be made to ascertain that the relay is operating if the battery charge is suspected of being marginal. This may be accomplished by removing the external power source and placing the battery switch in the ON position momentarily. If the indicator lights within the cockpit remain illuminated, the relay has closed.

DC Bus Selector Switch

The dc bus selector switch (5, figure 1-12) on the pilots' pedestal has NORM and EMER positions. In the NORM position, the emergency bus receives power from the main bus. When the switch is placed in EMER position, the battery and the emergency dc bus are isolated from the rest of the system. Power is supplied to the emergency bus by the battery when the battery switch is on.

Generator Switches

Two generator switches (figure 1-23) are located on the dc power control panel on the pilots' pedestal. The switches are guarded in the ON position and have two

FUEL QUANTITY DATA TABLE

TANK	NUMBER OF TANKS	USABLE FUEL (EACH TANK)	UNUSABLE FUEL (EACH TANK)	EXPANSION SPACE (EACH TANK)	TOTAL VOLUME (EACH TANK)
MAIN	2	765 GAL.	2.5 GAL.	23 GAL.	790.5 GAL.

NOTE
BASED ON NACA STANDARD ATMOSPHERE
6.0 POUNDS PER GALLON.

24023

Figure 1-20

other positions, OFF and RESET. From the reset position the switches are spring-loaded to the OFF position. When abnormal voltage output, approximately 32 volts, has caused a generator to be automatically cut off, the generator may be started again by momentarily holding the generator switch in the RESET position and then placing it in the ON position. If the generator failure warning light does not go out when the switch is returned to the ON position a malfunction of the generator is indicated, and the generator switch must be turned to the OFF position to prevent the operative generator voltage being pulled down by action of the equalizer circuit. If the generator failure warning light goes out when the generator switch has been moved to RESET and returned to ON, the generator is again supplying power and affected circuits have been reconnected. However, if the light illuminates again the generator is not functioning properly and the switch must be turned off and the electrical load on the operative generator reduced as much as possible.

Generator Voltage Control Rheostats

Each generator has two voltage control rheostats. One is located on the generator control panel below the cabin floor. It is adjusted by ground personnel. The other is located on the pedestal dc power control panel (figure 1-23). It is also set by ground personnel, but can be reset in flight by qualified personnel if such adjustment appears to be necessary. The pedestal voltage control rheostats are guarded by a spring-loaded plastic cover placarded with the appropriate adjustment warning. If the loadmeters show a difference of more than 10 percent of the total load carried by the two generators, the low loadmeter reading may be used as a standard while the voltage control rheostat of the opposite generator is adjusted until the reading of the two loadmeters are approximately equal. The output of either generator should not be allowed to exceed 28.5 volts. The engines must be operating at the same rpm when such adjustment is attempted. Voltage output of the two generators may not be equal after the load equalizing adjustment has been accomplished. Automatic devices in the generator voltage control systems will cut out either generator automatically if output rises to more than approximately 32 volts, or if generator voltage drops low enough to cause the current to reverse and flow from the bus to the generator.

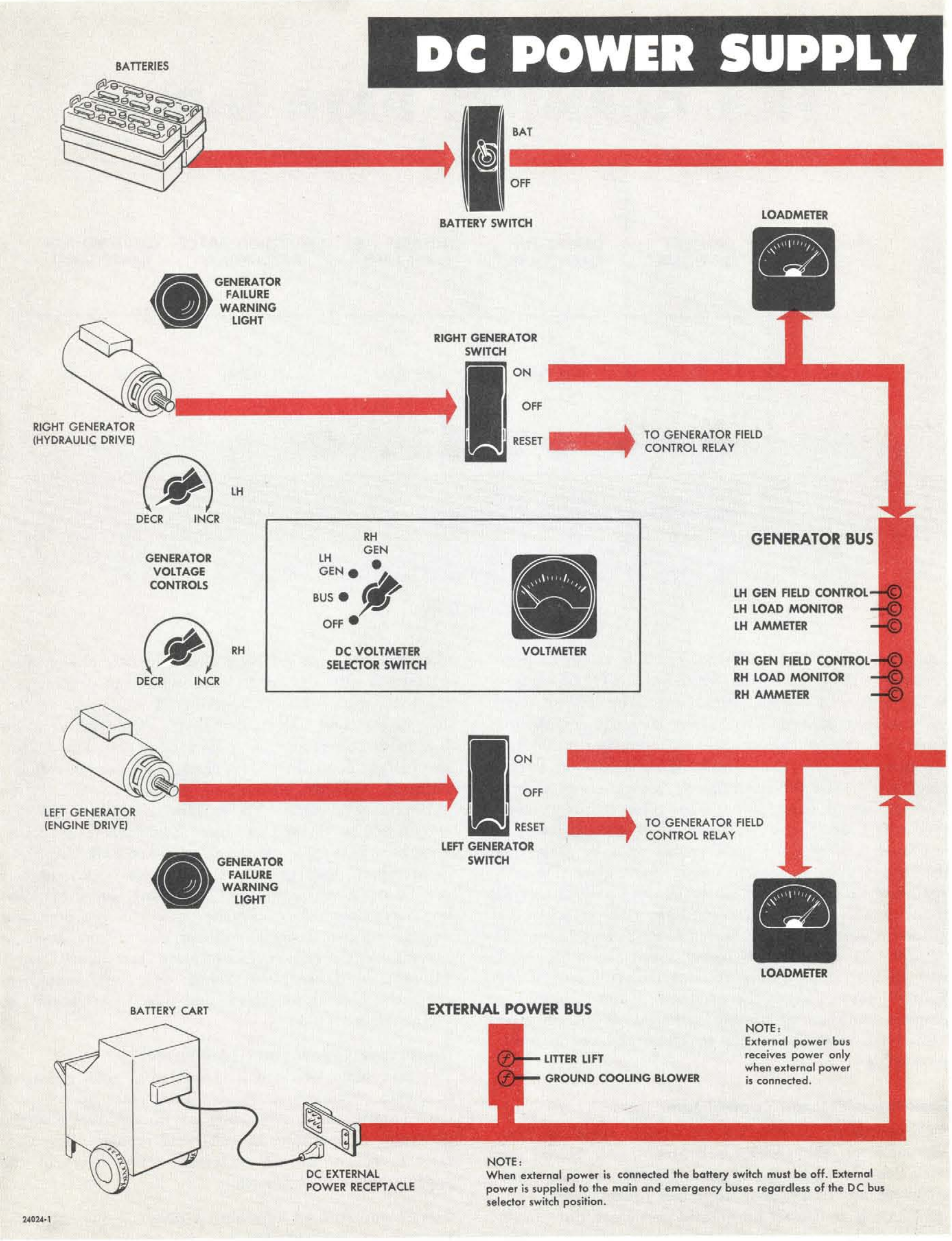
Generator Loadmeters (Ammeters)

The percentage of rated load carried by each generator is shown continuously on two loadmeters on the pedestal (figure 1-23). A reading of 1.0 indicates that the generator is operating at full rated capacity. The generators are capable of carrying a 50% overload for approximately two minutes.

Generator Failure Warning Lights

Two red generator failure warning lights (figure 1-23) are mounted on the pedestal dc power control panel.

DC POWER SUPPLY

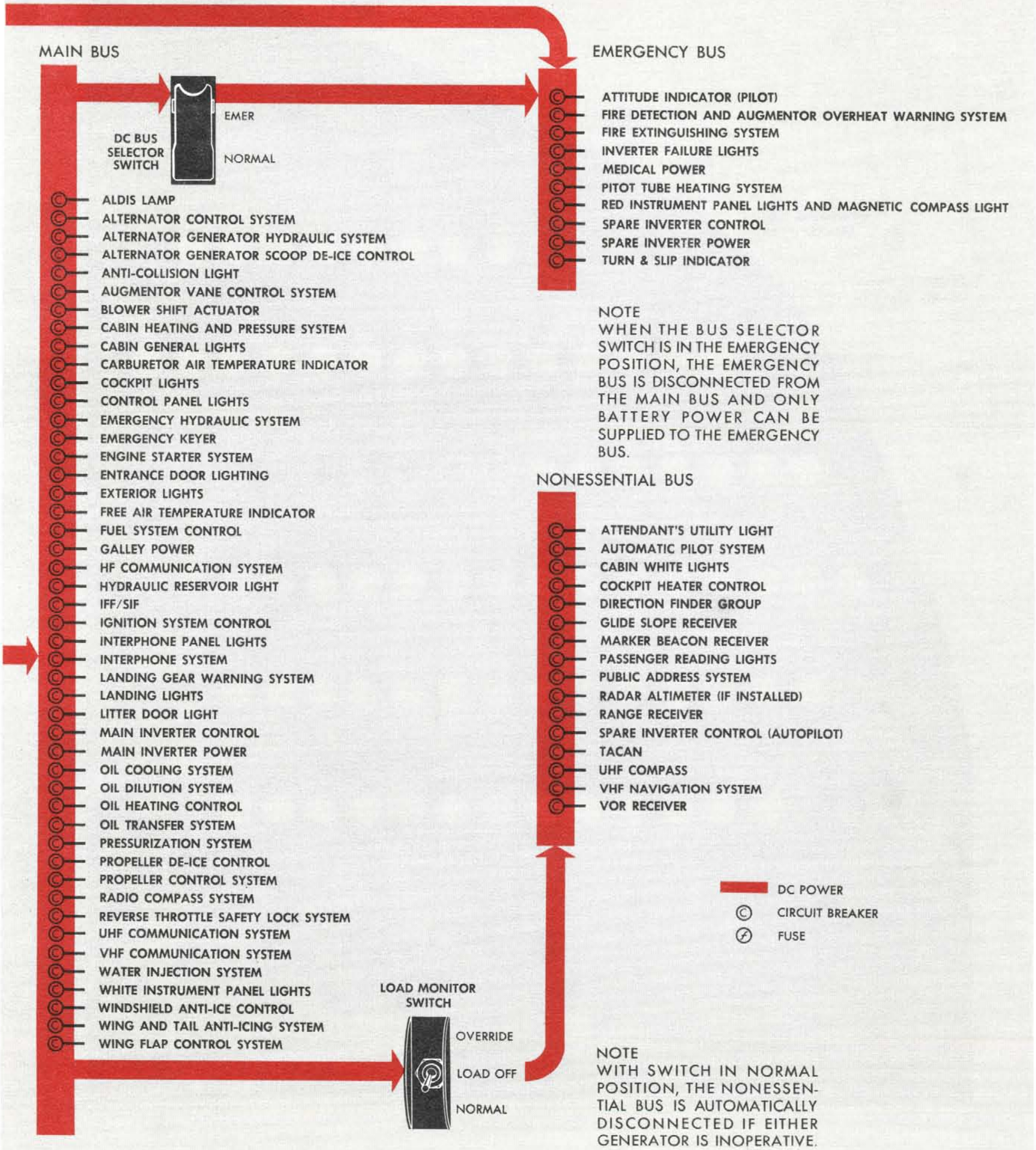


NOTE:
External power bus receives power only when external power is connected.

NOTE:
When external power is connected the battery switch must be off. External power is supplied to the main and emergency buses regardless of the DC bus selector switch position.

Figure 1-21

SYSTEM

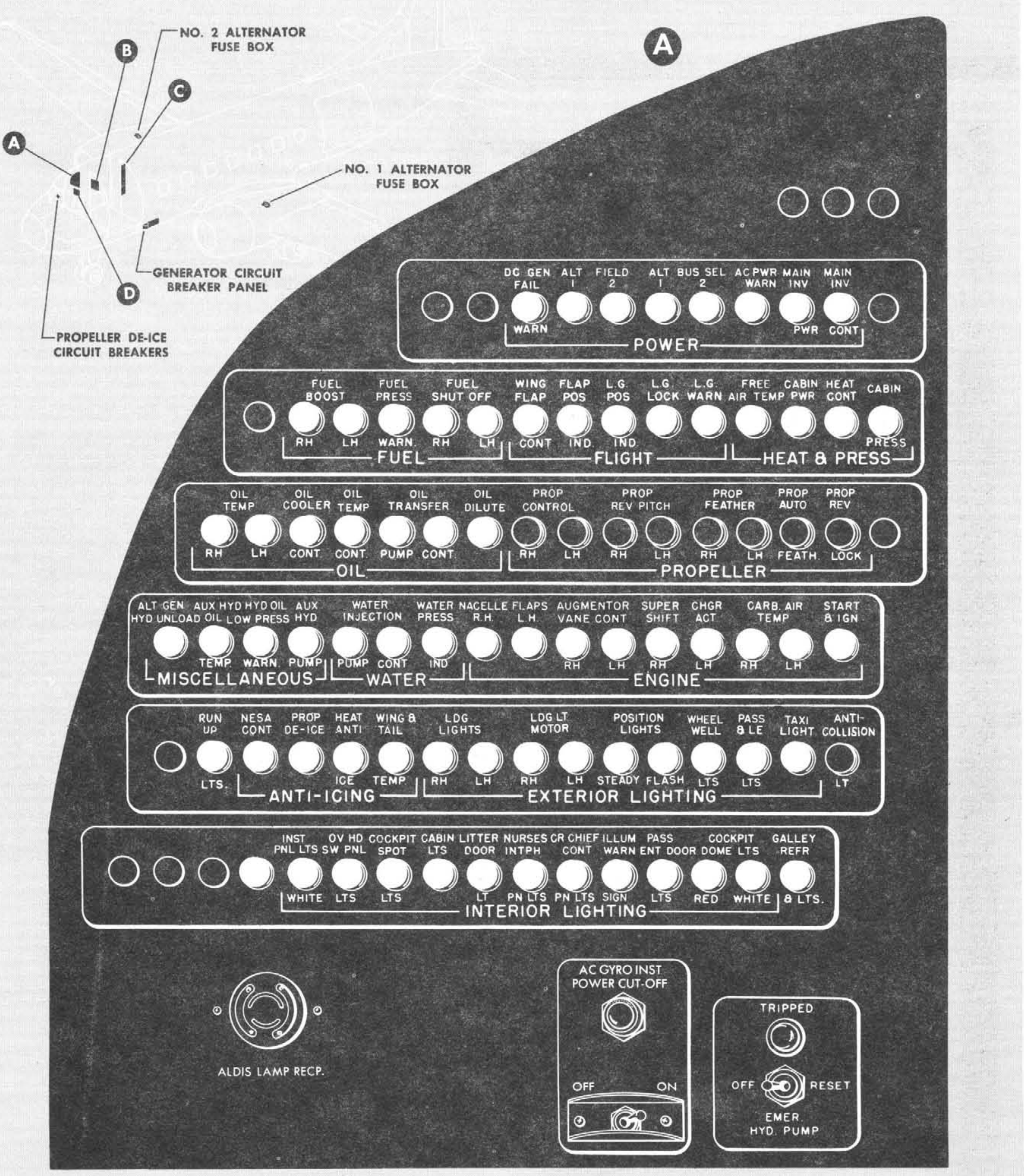


NOTE
WHEN THE BUS SELECTOR SWITCH IS IN THE EMERGENCY POSITION, THE EMERGENCY BUS IS DISCONNECTED FROM THE MAIN BUS AND ONLY BATTERY POWER CAN BE SUPPLIED TO THE EMERGENCY BUS.

NOTE
WITH SWITCH IN NORMAL POSITION, THE NONESSENTIAL BUS IS AUTOMATICALLY DISCONNECTED IF EITHER GENERATOR IS INOPERATIVE.

24024-2

CIRCUIT BREAKER AND

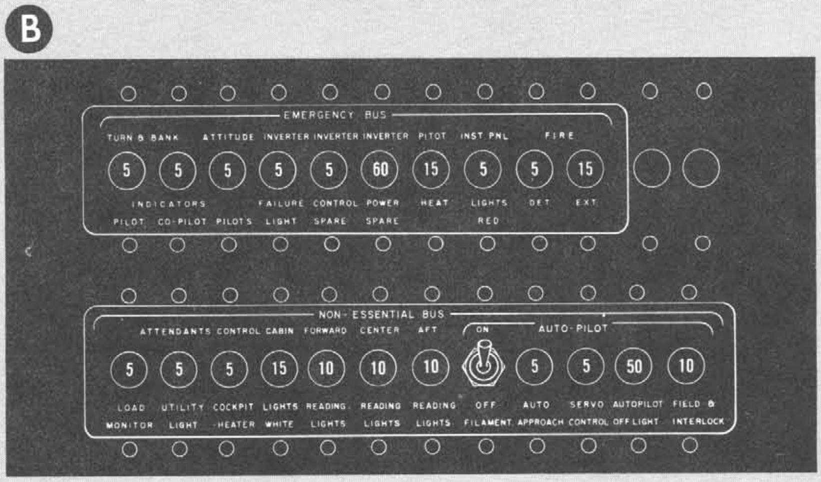


MAIN CIRCUIT BREAKER PANEL

24025-1

Figure 1-22

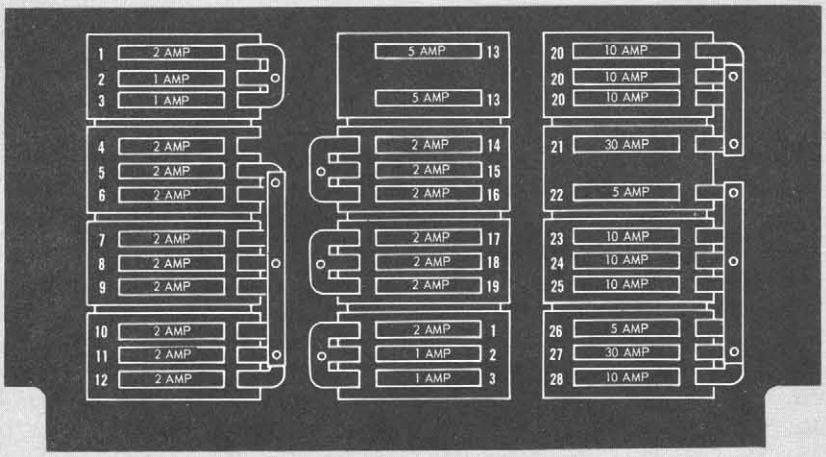
FUSE PANEL LOCATIONS (TYPICAL)



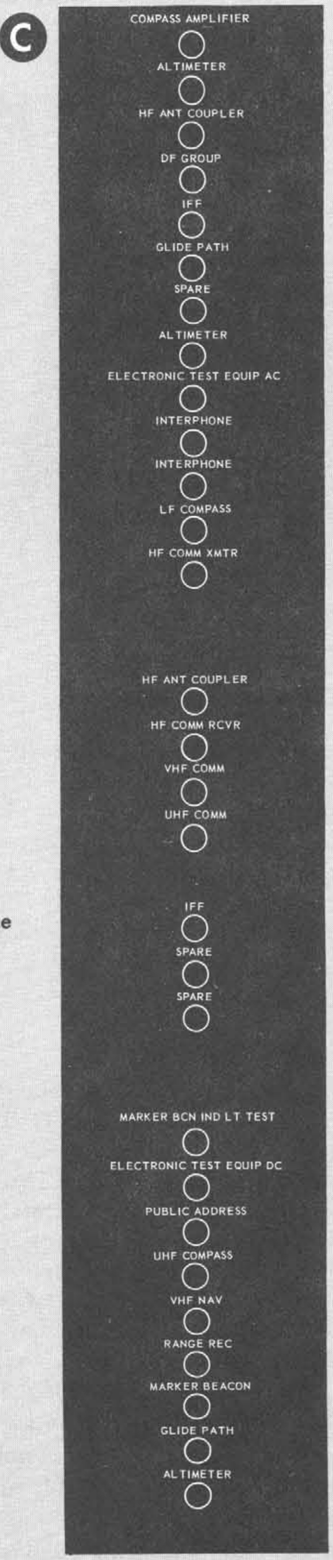
EMERGENCY BUS AND NON-ESSENTIAL BUS CIRCUIT BREAKER PANEL

D

1. Pilot's Attitude Indicator
2. Copilot's Attitude Indicator
3. Directional Indicator
4. Transformer
5. Auxiliary Hydraulic Oil Pressure Gage
6. Brake and Hydraulic Pressure Gage
7. RH Fuel Pressure Gage and Torquemeter
8. LH Fuel Pressure Gage and Torquemeter
9. RH Fuel Flowmeter and Water Pressure Gage
10. LH Fuel Flowmeter and Water Pressure Gage
11. RH Oil Pressure Gage and Augmentor Vane Position Indicator
12. LH Oil Pressure Gage and Augmentor Vane Position Indicator
13. Autopilot
14. Reserve Oil Quantity Gage
15. LH Oil Quantity Gage
16. RH Oil Quantity Gage
17. LH Fuel Quantity Gage
18. RH Fuel Quantity Gage
19. Cabin Heat
20. Cockpit Heater
21. Galley Power
22. Windshield Anti-Ice Start
23. Direct Vision Windshield Anti-Ice
24. RH Windshield Anti-Ice
25. LH Windshield Anti-Ice
26. Alternator/Generator Scoop De-Ice
27. Reserve Oil Heater
28. Oil Heater



FUSE BOX (ON AFT SIDE OF FLIGHT COMPARTMENT BULKHEAD)



RADIO CIRCUIT BREAKER PANEL

24025-2

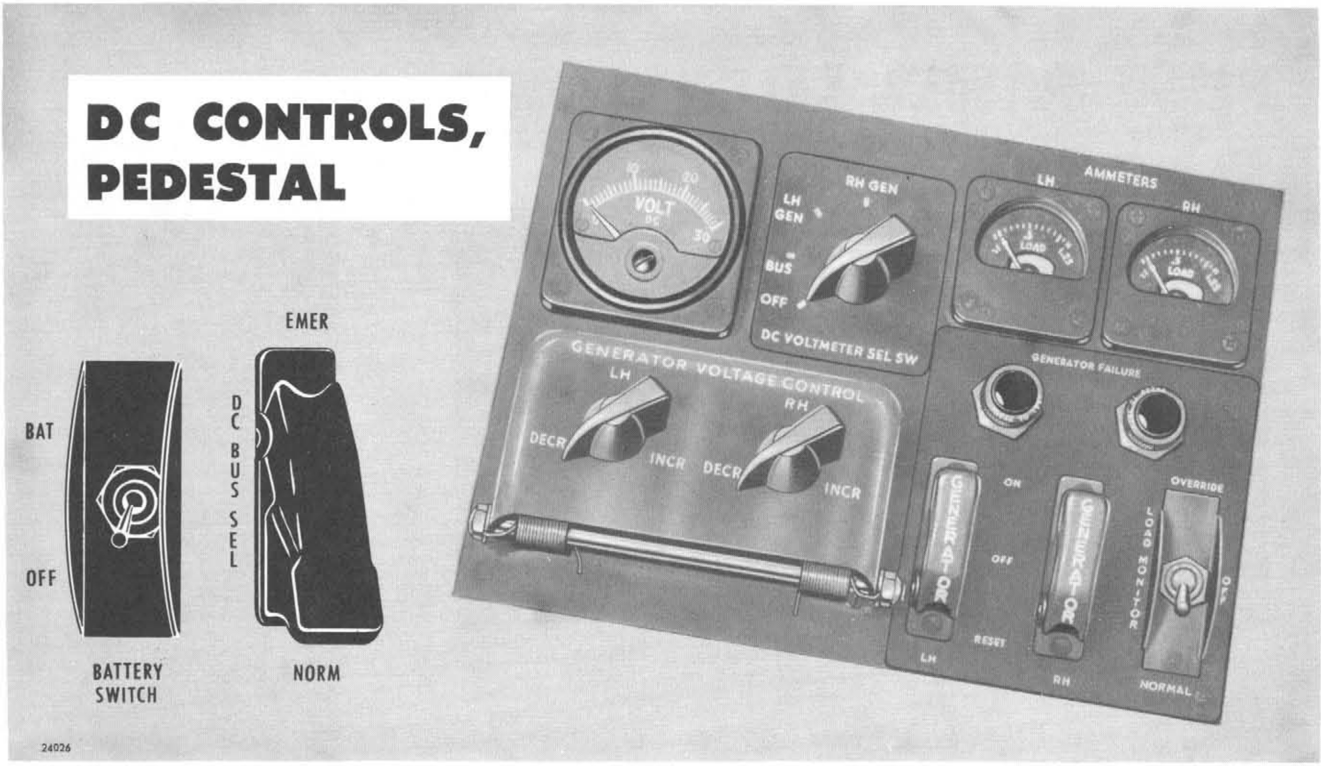


Figure 1-23

With the generator switches held to ON, illumination of one of the lights indicates that the corresponding generator output has been disconnected from the bus or that the generator is inoperative. If the generator failure warning light remains on after the generator switch has been momentarily held to RESET and returned to the ON position, a malfunction is indicated and the generator switch must be turned to OFF. The warning light is powered by the main dc bus.

Load Monitor Switches

A side-guarded load monitor switch (figure 1-23), having NORMAL, LOAD OFF, and OVERRIDE positions, is located on the pedestal dc power control panel. In the NORMAL position the switch energizes a load monitor relay that connects dc nonessential equipment buses to their corresponding power sources. If the output of either generator exceeds upper or lower limits the load monitor relays automatically disconnect the nonessential equipment from the buses. The equipment may be operated again by positioning the load monitor switch to OVERRIDE, which frees the relays of the monitoring effect of generator voltage. The switch must be placed in OVERRIDE to operate the affected equipment by external power sources during ground tests. Moving the switch to the OFF position disconnects the nonessential bus. The purpose of the load monitoring relay is to prevent overloading of one generator when the other generator has failed. Lighting of either of the generator failure warning lights, or a sudden drop in loadmeter reading, indicates that the load monitor relays have been deenergized and the affected equipment disconnected.

External DC Power Receptacle

An external dc power receptacle (figure 1-24) for connecting an external power source to the generator dc bus is located on the right side of the fuselage forward of the entrance door. External dc power is normally used for ground operation and tests if the left engine is not operating above 1000 rpm. External power must be disconnected prior to starting the right engine. When an external dc power source is not available, the batteries may be used to operate essential dc powered equipment or to start either engine.

DC Voltmeter and Voltmeter Selector Switch

A dc voltmeter and selector switch are located on the dc power control panel (figure 1-23) on the pilots' pedestal. Positions of the selector switch are OFF, BUS, LH GEN, and RH GEN. When the switch is placed in the BUS position, the voltmeter will indicate the voltage of the main dc bus. When the switch is placed in either the LH GEN or RH GEN position, the voltmeter will indicate the voltage output of the selected generator, provided the corresponding generator switch is off.

REGULATED AC POWER SUPPLY SYSTEM

Two dc operated 750 VA inverters supply three-phase and single-phase constant frequency 115-volt ac power to two buses (figure 1-25). Selection can be made between the main and spare inverters; however, the main inverter is normally used and the spare inverter is selected only if the main inverter becomes inoperative. A stepdown transformer provides 26-volt regulated ac power for operation of some instruments. See figure 1-25 for regulated ac operated equipment.

Inverter Circuit Breakers

Five circuit breakers protect the inverter circuits. Two circuit breakers, placarded "Main Inv Pwr" and "Main Inv Cont," are located on the main circuit breaker panel (figure 1-22). Three circuit breakers, placarded "Inverter Failure Light," "Inverter Control Spare," and "Inverter Power Spare," are located on the emergency bus circuit breaker panel (figure 1-22).

Inverter Selector Switch

The inverter selector switch on the ac power control panel (figure 1-27) has three positions: MAIN, OFF, and SPARE (AUTOPILOT OFF). In the MAIN position the main dc bus supplies power to the main inverter, which in turn provides three-phase and single-phase regulated 115-volt power for flight and engine instruments. If the main inverter output fails, the corresponding warning light will illuminate and the inverter switch must be manually placed in the SPARE position. In this position, the emergency dc bus supplies power to the spare inverter, which then assumes the main inverter load, and the autopilot and C-1 compass amplifier circuits are automatically disconnected.

Inverter Failure Warning Lights

Two inverter failure warning lights (figure 1-27) are located above the inverter switch on the pilots' pedestal. They are placarded "Main Out" and "Spare Out" and indicate when the corresponding inverter is disconnected or inoperative.

Autopilot Filament Breaker Switch

A circuit breaker switch with ON and OFF positions is located on the nonessential bus circuit breaker panel. When the switch is placed in the ON position, dc power from the nonessential bus is supplied to the spare inverter and to the autopilot filaments, if the inverter selector switch is in the MAIN or OFF position. Should the inverter selector switch be placed in the SPARE position, the autopilot and the C-1 amplifier are automatically disconnected and the spare inverter assumes the main inverter load, obtaining power from the emergency dc bus.

AC Voltmeter and AC Voltmeter Selector Switch

Bus voltages of either the regulated ac system or the unregulated ac system can be read on the voltmeter located on the ac power control panel (figure 1-27) on the pilots' pedestal. The ac voltmeter selector switch is used to select the bus voltage to be read on the voltmeter.

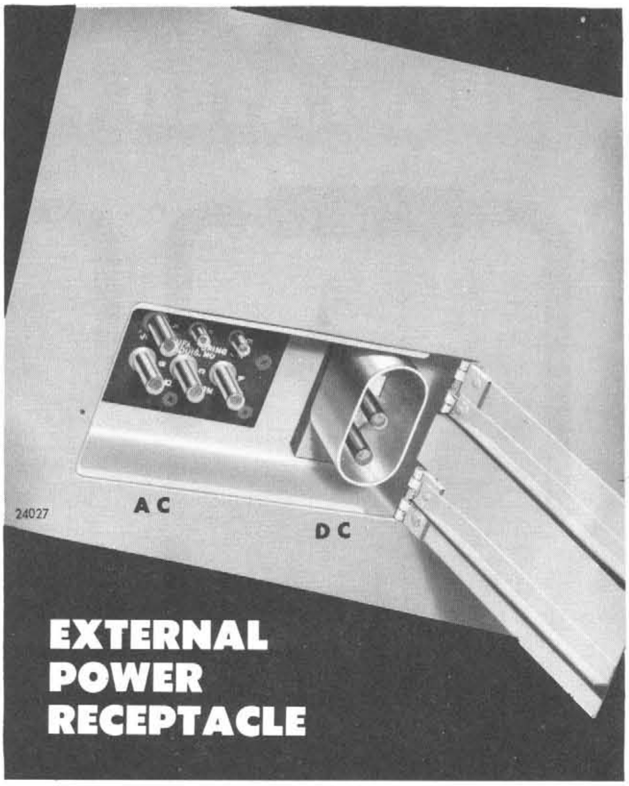


Figure 1-24

The switch has an OFF position and five ac bus positions: ALTRN NO. 1, ALTRN NO. 2, MAIN INV, SPARE INV, and 26V. The two ALTRN positions select unregulated ac voltage readings; MAIN INV, SPARE INV, and 26V positions select regulated ac voltage readings.

UNREGULATED AC POWER SUPPLY SYSTEM

Two 8-kva self-excited alternators supply 115-volt variable frequency single-phase ac power to two buses. (See figure 1-26.) One alternator, known as No. 1, is driven by the left engine, the other alternator, known as No. 2, is driven by a hydraulic motor in the right nacelle. The two unregulated ac buses can be selectively powered by either alternator or by external ac power. See figure 1-26 for equipment operated by unregulated ac power.

External AC Power Receptacle

An external ac power receptacle (figure 1-24) for supplying power to the unregulated ac buses is located on the right side of the fuselage forward of the entrance door. External power is directed to one bus or the other by positioning the alternator selector switch.

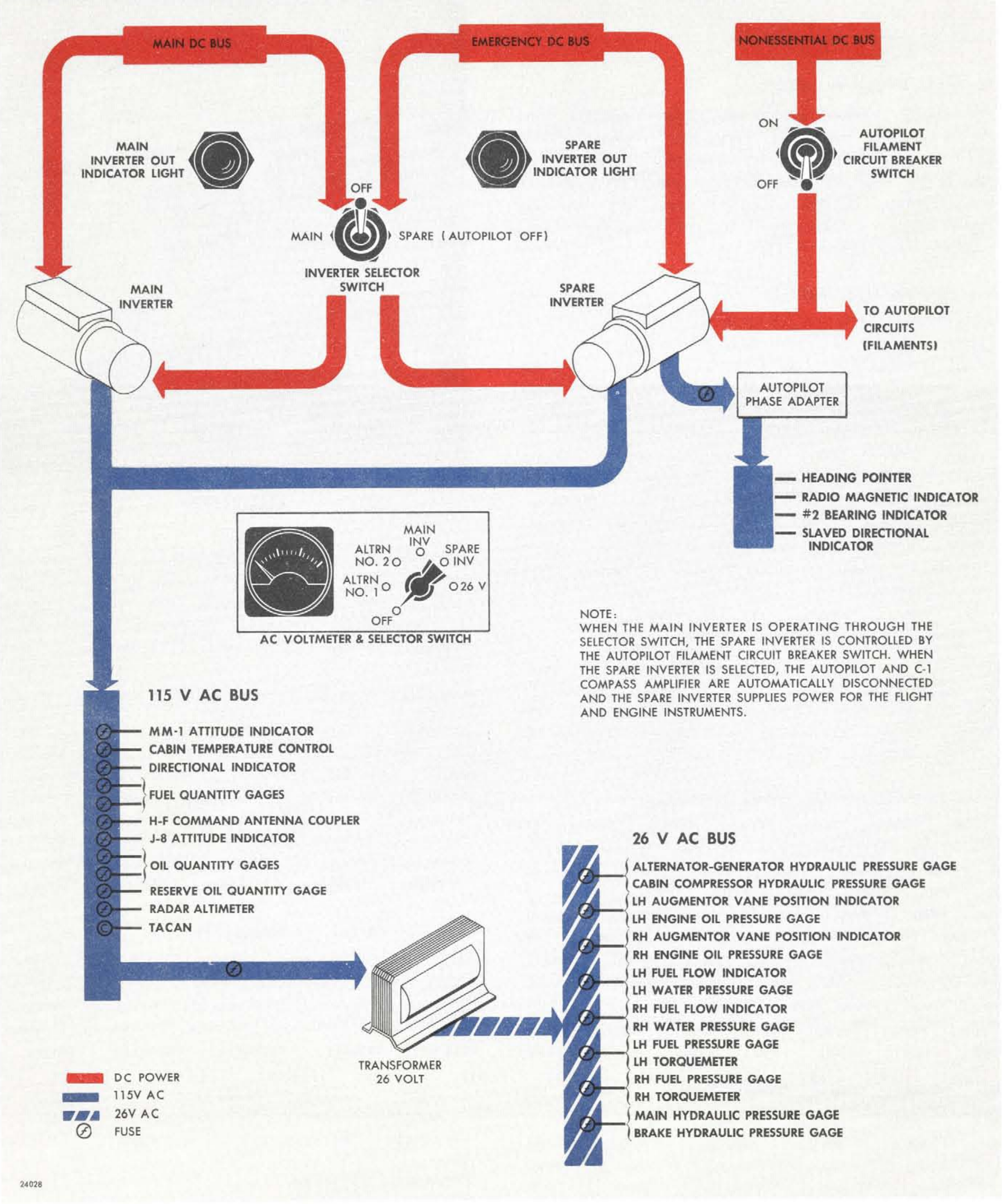
Note

External power can be supplied to only one of the unregulated ac buses at a time.

Alternator Switches

Two alternator switches (3, figure 1-12) are located on the ac power control panel on the pilots' pedestal. These

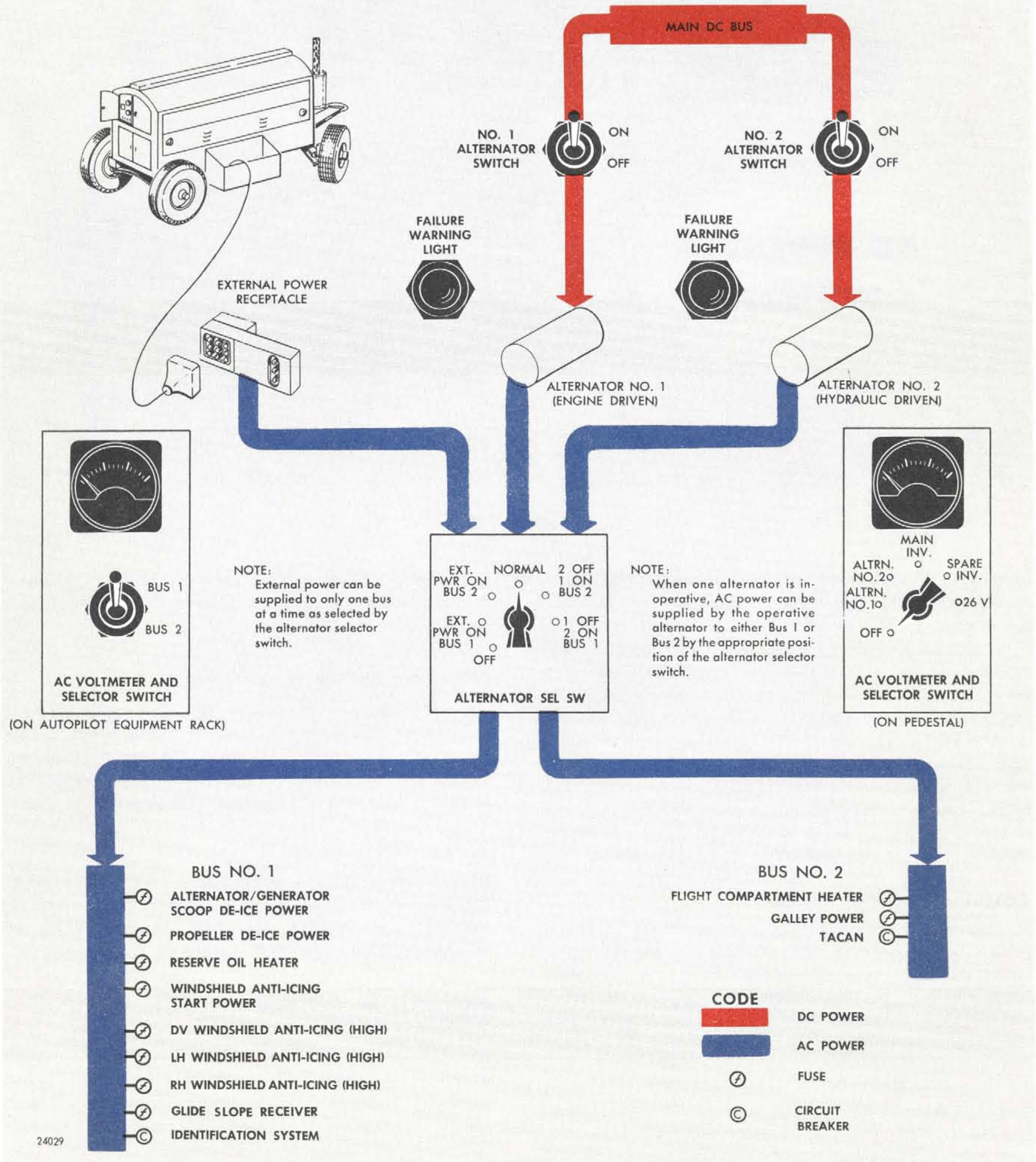
REGULATED AC POWER SYSTEM



NOTE:
WHEN THE MAIN INVERTER IS OPERATING THROUGH THE SELECTOR SWITCH, THE SPARE INVERTER IS CONTROLLED BY THE AUTOPILOT FILAMENT CIRCUIT BREAKER SWITCH. WHEN THE SPARE INVERTER IS SELECTED, THE AUTOPILOT AND C-1 COMPASS AMPLIFIER ARE AUTOMATICALLY DISCONNECTED AND THE SPARE INVERTER SUPPLIES POWER FOR THE FLIGHT AND ENGINE INSTRUMENTS.

Figure 1-25

UNREGULATED AC POWER SUPPLY SYSTEM



NOTE:
External power can be supplied to only one bus at a time as selected by the alternator selector switch.

NOTE:
When one alternator is inoperative, AC power can be supplied by the operative alternator to either Bus I or Bus 2 by the appropriate position of the alternator selector switch.

Figure 1-26

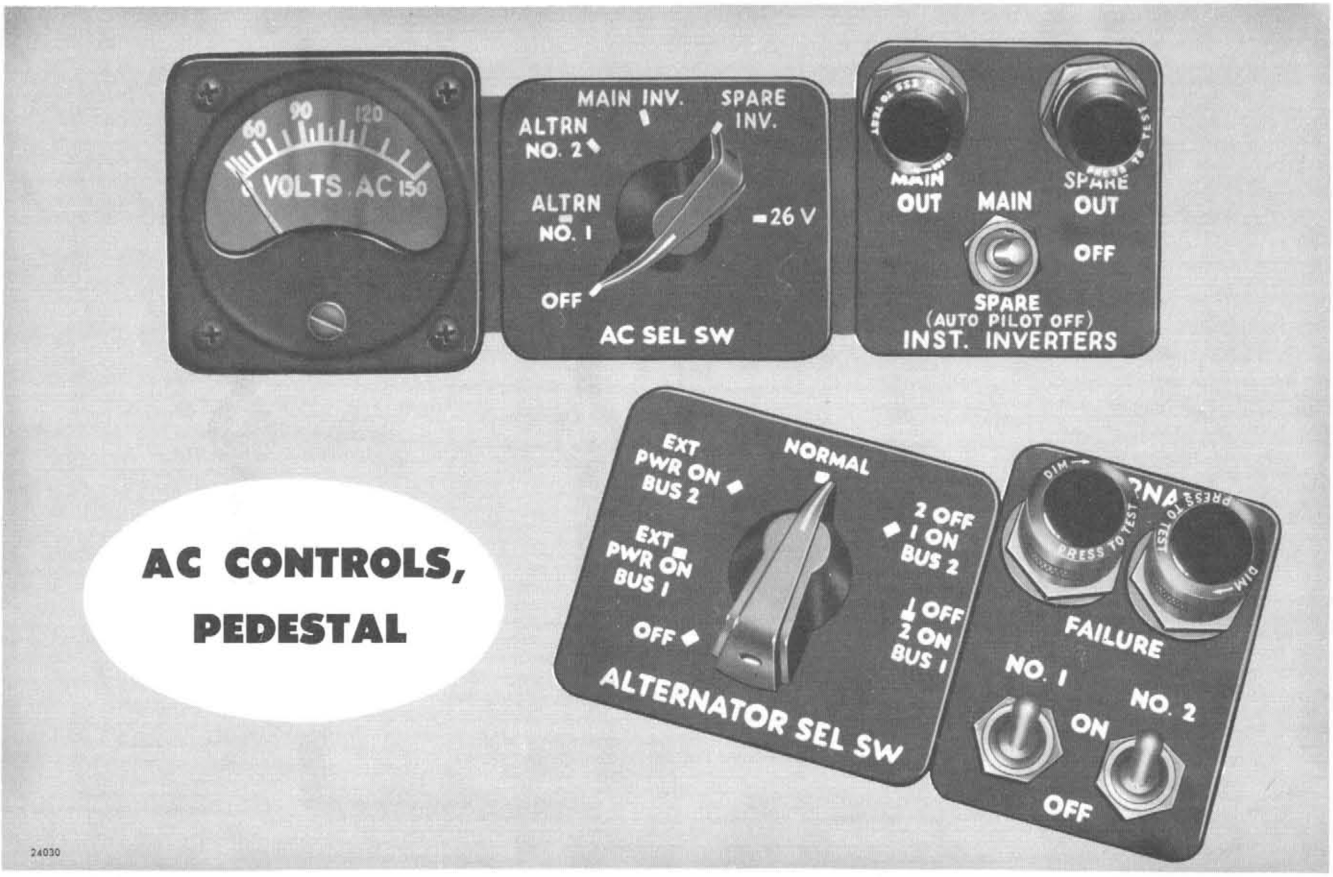


Figure 1-27

switches control dc power to the fields of the alternators, through the alternator voltage regulators. The switches are placarded "No. 1" and "No. 2," indicating left and right alternators, and have ON and OFF positions. The switches are placed in the ON position for normal operation. Immediately after the switches are placed in the ON position the alternator voltages will indicate normal if dc power is available and engines are developing at least 1250 rpm. After approximately 30 seconds the voltage will drop off and a slow increase to full voltage will begin. If the alternator-generator hydraulic system switch is turned to OFF, No. 2 alternator will not function, regardless of the No. 2 alternator switch position.

Alternator Selector Switch

The alternator selector switch (3, figure 1-12), on the ac power control panel, is used to select the distribution of unregulated ac power. When the switch is in the NORMAL position, the No. 1 alternator supplies No. 1 bus and the No. 2 alternator supplies No. 2 bus (figure 1-25). Other selector switch positions are: OFF, EXT PWR ON BUS 1, EXT PWR ON BUS 2, 2 OFF–1 ON BUS 2, 1 OFF–2 ON BUS 1. When in the EXT PWR ON BUS 1 position, external unregulated ac power is connected to bus No. 1. When in the EXT PWR ON BUS 2 position, external unregulated ac power is connected to bus No. 2. When in the 2 OFF–1 ON BUS 2 position, No. 2 alternator is disconnected and No. 1 alternator is connected to bus No. 2. When in the 1 OFF–2 ON BUS 1 position, No. 1 alternator is disconnected and No. 2 alternator is connected to bus No. 1.

Alternator Failure Warning Lights

Two red alternator failure warning lights (3, figure 1-12) are located immediately forward of the ac power control panel. An inoperative or failed alternator causes the corresponding warning light to illuminate provided the alternator switch is on The lights are dc powered.

AC Voltmeter

Bus voltage of the unregulated ac system can be read on the ac voltmeter (figure 1-27), located on the ac power control panel. Refer to AC VOLTMETER AND AC VOLTMETER SELECTOR SWITCH, this Section.

Alternator AC Voltmeter and Voltmeter Selector Switch

An unregulated ac voltmeter and voltmeter selector switch are installed in the upper right corner of the forward side of the electrical (autopilot) equipment rack in the cabin. The selector switch has two positions, BUS NO. 1 and BUS NO. 2, for selecting the alternator voltage to be read on the voltmeter when checking the alternator voltage regulators.

ALTERNATOR-GENERATOR HYDRAULIC SYSTEM

The right generator and the No. 2 alternator are hydraulically driven by a single pump on the right engine. (See figure 1-28.) The alternator-generator hydraulic system is not connected to the airplane's main hydraulic power supply system. It has an accumulator, nitrogen pressure bottle, and accumulator pressure gage on a servicing panel in the trailing edge of the right wing. The hydraulic motor is started and stopped by an electrically operated bypass valve in the pressure line between the pump and the motor. A switch on the copilot's console supplies dc power to open or close the system bypass valve. The hydraulic pump operates whenever the right engine is running. With the alternator-generator hydraulic system switch in ON position and the right engine operating at 1000 to 1200 rpm, the output of the right generator will be high enough (24.5 volts) to connect it automatically to the dc bus, provided the generator switch is on. Should the system fail in flight, the system must be turned off and not turned on again until the defect has been corrected on the ground. The system pressure will vary widely, depending partly on engine rpm and partly on generator and alternator load. If pressure exceeds 3450 psi a relief valve will route some fluid, under pressure, to the return manifold. A temperature gage is provided to indicate temperature of hydraulic fluid in the return line to the pump. Excessive temperature indicates a malfunction in the system. Operation of the system must then be discontinued.

Alternator-Generator Hydraulic System Switch

A guarded ON-OFF alternator-generator hydraulic system switch (figure 4-2) is located on the copilot's console. When the switch is in the ON position, dc power is supplied through an unloading relay to the "close" side of the motor-driven actuator of the alternator-generator hydraulic bypass valve, thus routing pressure flow from the pump directly to the hydraulic motor. In the ON position, the unloading relay is not energized. The switch is kept on at all times as long as the right generator and No. 2 alternator are operating normally. When the switch is in the OFF position, the unloading relay is energized. DC power is then supplied to the "open" side of the bypass valve actuator allowing a pressure flow from the pump to the manifold without operating the hydraulic drive motor. A holding circuit in the unloading relay keeps the relay energized until the "Alt Hyd Unload" circuit breaker on the main circuit breaker panel is pulled momentarily to break the holding circuit which allows the relay to unload. Prior to resetting the circuit breaker, the system switch should be placed in the ON position and the switch guard closed.

Note

The alternator-generator hydraulic system switch must be placed in the ON position prior to resetting the circuit breaker to rearm the system. If the switch is left in the OFF position, the holding circuit will remain energized even though the circuit breaker is reset.

To prevent damage to the system and to reduce the possibility of fire, the switch must be turned to OFF if either the generator or alternator fails, the light illuminates, or excessive temperature is indicated.

No. 2 Engine Fluid-Off Handle

A hydraulic fluid shutoff valve is installed in the return line to the alternator-generator hydraulic pump. The valve is mechanically actuated by the No. 2 engine fluid-off handle (figure 1-37) on the fire control panel. Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.

Alternator-Generator Hydraulic Pressure Gage

A pressure gage (51, figure 1-7), on the copilot's flight instrument panel skirt, indicates the hydraulic pressure in the line from the pump to the alternator-generator drive motor. The gage is operated by 26-volt regulated ac power.

Alternator-Generator Hydraulic System Pressure-Low Warning Light

An amber pressure-low warning light (50, figure 1-7), illuminates whenever the return pressure drops below 69 psi. An illuminated light may indicate loss of fluid or pressurized nitrogen. The light will not illuminate when the system is inoperative. If the system is operating when the light illuminates, either a hydraulic leak or a nitrogen leak may be the cause. The system must be shut down immediately by turning the alternator-generator hydraulic system switch to the OFF position.

Alternator-Generator Hydraulic System Temperature Gage

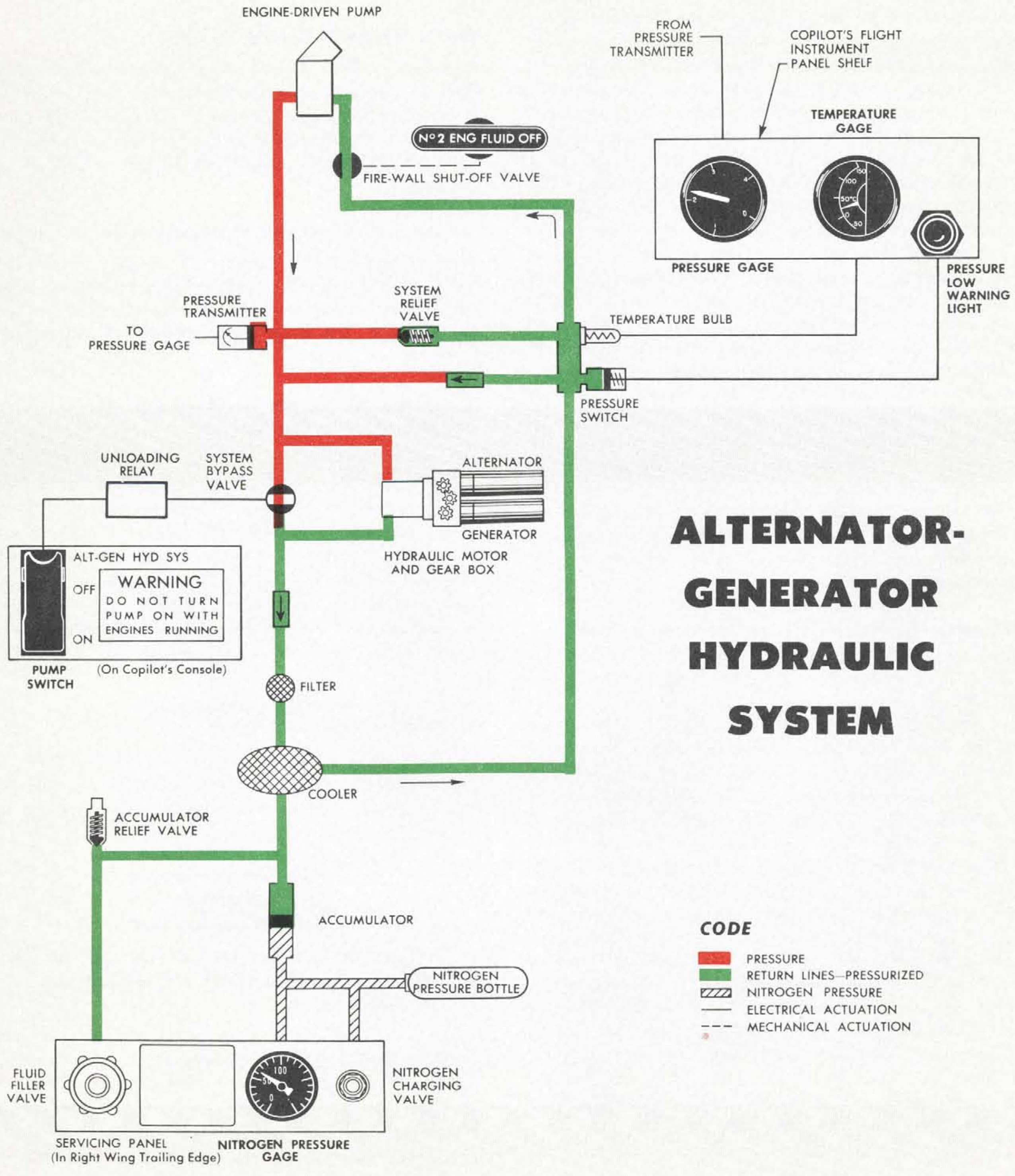
A temperature gage (52, figure 1-7) indicates the temperature of the hydraulic fluid in the return line from the hydraulic motor to the engine-driven pump. The temperature gage is operated by dc power.

CAUTION

The system must be turned off if the alternator-generator hydraulic system temperature exceeds maximum limits.

Alternator-Generator Hydraulic System Nitrogen Pressure Gage

A direct-reading pressure gage is provided on the alternator-generator hydraulic system servicing panel in the right wing trailing edge. The gage is used during servicing operations as placarded adjacent to the gage; it may also be checked for correct pressure during preflight exterior inspection in order to assure adequate return pressure in the alternator-generator hydraulic system. If the accumulator requires servicing and is not properly serviced before flight, the alternator-generator



ALTERNATOR-GENERATOR HYDRAULIC SYSTEM

CODE

🟥 PRESSURE
🟩 RETURN LINES—PRESSURIZED
▨ NITROGEN PRESSURE
— ELECTRICAL ACTUATION
--- MECHANICAL ACTUATION

Figure 1-28

hydraulic pressure-low warning light will illuminate as soon as dc power is supplied. Engine start must then be postponed until the accumulator has been serviced.

HYDRAULIC POWER SUPPLY SYSTEM

The hydraulic power supply system (figure 1-30) consists of two engine-driven variable displacement hydraulic pumps which maintain a constant pressure of approximately 3000 psi. The entire system may be operated under full pressure when required, or all of the system except the brakes and accumulator can be relieved of pressure when operated in bypass status. The engine-driven pumps will provide pressure to the brakes and accumulator, giving unlimited brake operation at all times when fluid is available in the normal supply system. An electrically operated emergency hydraulic pump provides pressure for the entire system in an emergency and a pneumatic system provides limited emergency brake operation. The emergency hydraulic pump may also be used to provide hydraulic pressure for ground operation when the engines are not running. The hydraulic reservoir, located aft of the radio rack, is provided with a sight gage and filler fitting. Test stand connections for ground operation and checking of the system are provided on a panel at the aft side of the nose landing gear well. The accumulator air pressure gage is also located on this panel. The accumulator must be charged with air on the ground to assure reserve pressure in the system. See figure 1-30 for hydraulically operated equipment. See figure 1-40 for hydraulic fluid specification.

Hydraulic Reservoir and Sight Gage

The hydraulic reservoir is installed in a housing located above the floor level aft of the radio rack. A sight gage (figure 1-29) on the reservoir can be read through a window in the aft side of the housing. Sight calibrations are: FULL – FLIGHT LEVEL, FULL – GROUND LEVEL – GEAR DOWN, REFILL – GROUND LEVEL, and EMERG. The reservoir has a fluid capacity of 6.2 U.S. gallons, of which 1.3 gallons are reserved for use with the emergency hydraulic pump. The total volume of the reservoir is 8.8 U.S. gallons, allowing 2.6 gallons volume for foaming.

Hydraulic Pressure Bypass Handle

A hydraulic pressure bypass handle (18, figure 1-12), on the aft face of the pilots' pedestal mechanically operates a bypass valve in the pressure supply line of the system. When the bypass handle is in the BYPASS (UP) position the system is depressurized except for the pressure accumulator where pressure is maintained by the pumps at approximately 3000 psi to provide adequate reserve pressure for brake operation. When the bypass handle is placed in the PRESS (DWN) position, the output of the variable displacement pumps is directed toward all components of the hydraulic system.

Emergency Hydraulic Pump Switch

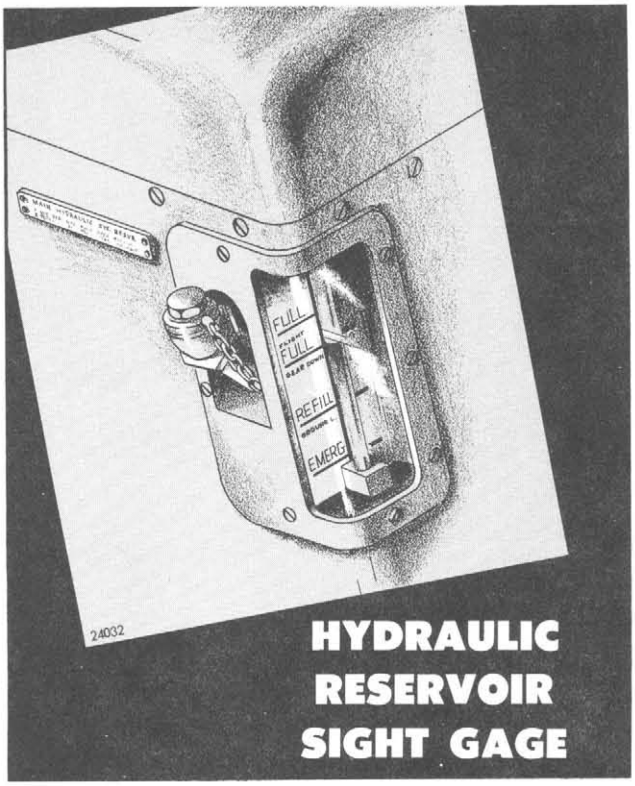
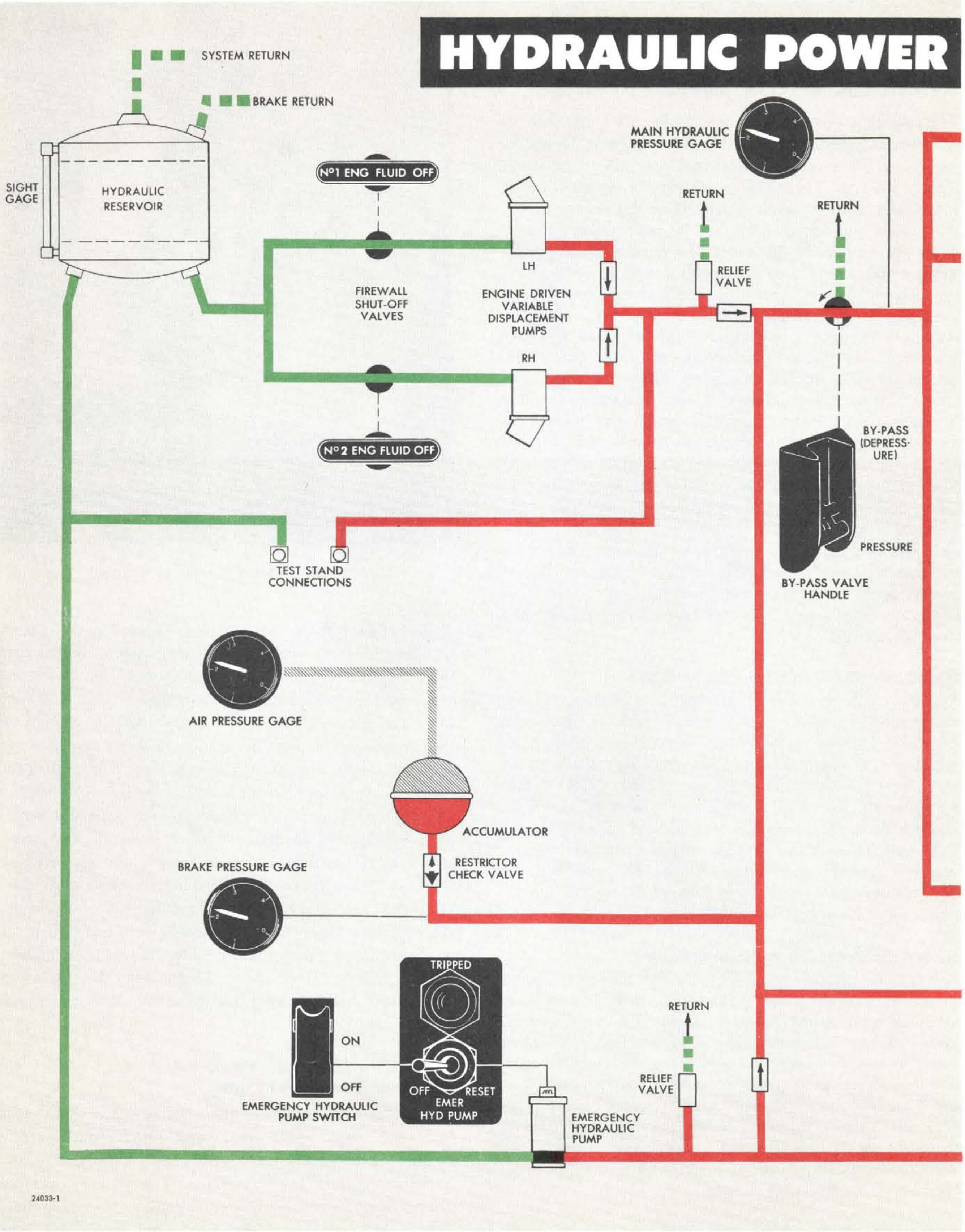


Figure 1-29

The emergency hydraulic pump switch (23, figure 1-12), connects and disconnects dc power to a motor operated pump which furnishes an alternate source of hydraulic pressure for operation of the system within the operating time limit of the pump motor. The switch has ON and OFF positions and is guarded to the OFF position. The pump can be used for operating the system on the ground when the engines are not running and test stand hydraulic pressure is not available. Under this condition, the pressure bypass handle must be in the PRESS (DWN) position, so that fluid pressure from the emergency pump can be directed to all lines of the system. If the bypass handle is up, emergency pressure will be available to the brakes, flaps, and litter loading door only. If, due to a line failure, the normal supply of hydraulic fluid in the system and reservoir has been exhausted, use of the emergency pump is limited to the 1.3-gallon reserve fluid supply in the reservoir. This reserve fluid provides for at least one full wing flap cycle and 12 to 15 normal brake applications.

Emergency Hydraulic Pump Reset Switch and Indicator Light

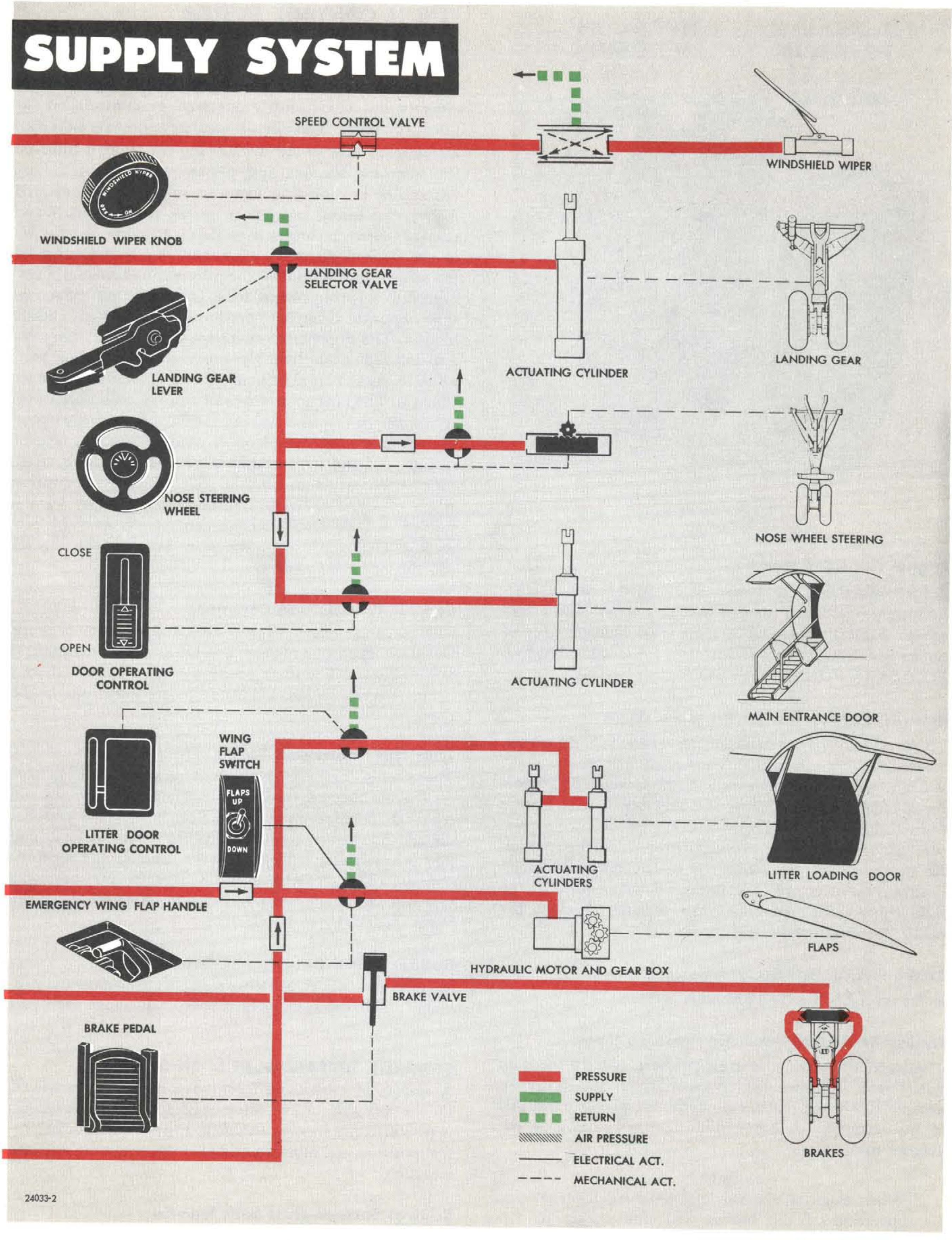
An emergency hydraulic pump reset switch and indicator light (16, figure 1-4) are located on the main circuit breaker panel behind the copilot's seat. If the emergency pump draws an excessive amount of dc power, a remote control circuit breaker trips, stopping the pump and lighting the indicator light. The switch below the light must then be held momentarily to the RESET position to reset the circuit breaker and start the pump.



HYDRAULIC POWER

Figure 1-30

SUPPLY SYSTEM



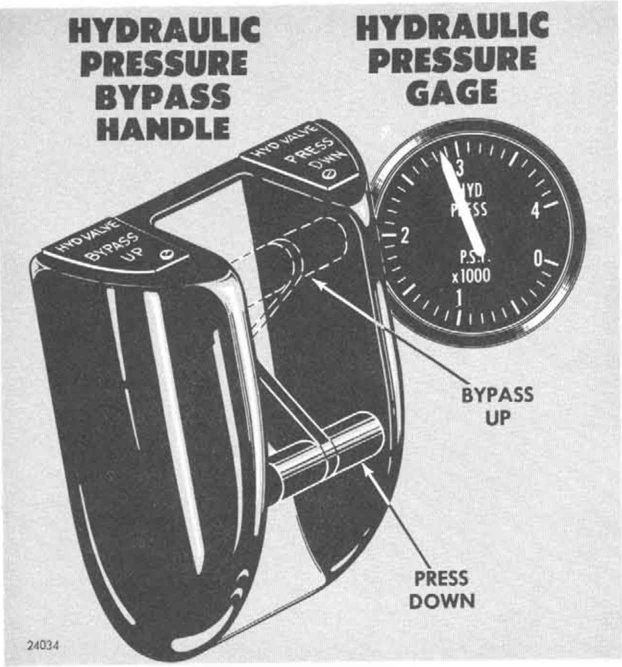


Figure 1-31

Engine Fluid-Off Handles

A hydraulic fluid shutoff valve is installed in the hydraulic supply line at the firewall in each nacelle. The valves are mechanically actuated by the engine fluid-off handles on the fire control panel (figure 1-37). Refer to ENGINE FIRE EXTINGUISHER SYSTEM, this Section.

Main Hydraulic System Pressure Gage

The main hydraulic system pressure gage (55, figure 1-7), located on the copilot's flight instrument panel shelf, is connected to a pressure transmitter powered by 26-volt regulated ac power. When the pressure bypass handle is in the PRESS (DWN) position, the hydraulic pressure gage indicates the pressure throughout the hydraulic system; when the handle is in the BYPASS (UP) position, the pressure gage indicates the pressure of the fluid being circulated under low pressure through the major portion of the system only.

Brake Hydraulic Pressure Gage

Refer to BRAKE SYSTEM, this Section.

Hydraulic Accumulator Air Pressure Gage

The hydraulic accumulator air pressure gage in the nose wheel well indicates the air pressure in the hydraulic accumulator when there is no hydraulic pressure trapped in the accumulator. The accumulator is charged on the ground to 1000 psi.

Note

When engines are not running, intermittent operation of the brakes with the system in bypass will drain the accumulator hydraulic charge.

FLIGHT CONTROL SYSTEM

The primary flight control surfaces are mechanically operated by conventional dual wheels and pedals. Conventional trim tabs on the ailerons, rudder, and right elevator are mechanically operated by controls on the pilots' pedestal. The aileron and elevator trim tabs also act as servo tabs to aid in reducing the control force on the ailerons. Rudder and elevator control forces are reduced by the boosting action of automatically operated flight tabs. Initial movement of the rudder pedals and control system produces a tendency to move the rudder in the desired direction. However, due to resistance of the airflow on the rudder, the pilot-applied force is transmitted to a spring torque tube, and flight tab motion in the opposite direction produces the desired rudder motion. The flight tabs are independent of the trim tabs. Tension regulators limit the range of cable tension variation in the principal control systems despite temperature changes. The aileron and rudder control cables are interconnected to improve lateral stability during low-speed flight. This interconnection is accomplished by use of springs and can be overridden when necessary to cross-control the airplane. Curtain seals between the trailing edges of the stabilizers and the leading edges of the rudder and elevators increase control efficiency by preventing airflow through the slots between the control surfaces and the stabilizers.

Control Wheels and Columns

Each control wheel (figure 1-4) incorporates a dome floodlight button, a microphone button, and an autopilot release button. The static position of the control columns is "nose down" (forward), due to a bob weight in the system.

Trim Tab Knobs and Position Indicators

The aileron trim tab knob (17, figure 1-12) is located on the aft face of the pilots' pedestal, and the aileron trim tab position indicator is located on the pedestal directly above the knob. The rudder trim tab knob and position indicator is located on the top face of the pilots' pedestal. The elevator trim tab wheels and indicators (10 and 18, figure 1-11) are located on each side of the pilots' pedestal.

Rudder Pedal Adjustment Cranks

A crank for rudder pedal fore-and-aft adjustment is provided under the instrument panel shelf above each pair of pedals.

CONTROL SURFACE GUST LOCK SYSTEM

A system of cables and lock pins operated by a handle on the left side of the pilots' pedestal quadrant section is provided for locking the main control surfaces in neutral position and blocking the throttles when the airplane is parked.

Control Surface Gust Lock Handle

A control surface gust lock handle (2, figure 1-11), is provided to lock the control surfaces in neutral when the airplane is parked. When the handle is forward it is in the UNLOCKED position. To lock the controls the handle is eased back while turning the aileron control wheel to line up the hole in the stop plate at the ailerons with the gust lock pin. Attempts to force the gust lock handle aft to the ELEVATOR or RUDDER positions before the AILERON (and, subsequently, the ELEVATOR) position has been locked will damage the stop plates. Locking the elevators and rudder requires similar "hunting" with the control column and the rudder pedals in order to seat the corresponding lock pin in the stop plate holes. When the handle has been brought aft in this manner to LOCKED position, a projection on the handle prevents forward movement of the throttles. A latch operated by a control lock release pushbutton in the left end of the handle prevents inadvertent unlocking of the control surfaces. The latch is released by depressing the control lock release button and allowing the handle to move forward to the spring-loaded UNLOCKED position. The control column should be held to prevent it from slamming forward to the nose-down position. This same latch prevents inadvertent movement of the handle from UNLOCKED to LOCKED position.

WING FLAP SYSTEM

The two Fowler-type wing flaps are operated synchronously to the same setting by a hydraulic motor at the wing flap drive gearbox. Wing flap drive shafts protruding from the left and right sides of the gear box mechanically drive both flaps. Limit switches open the control circuit when the wing flaps have reached the down or up limit. The wing flap position transmitter takes readings directly from the drive gearbox. Manual emergency operation of the electrically operated selector valve is provided for use in event of electrical failure. Full extension or retraction of the wing flaps requires approximately 15 seconds. In DOWN position the flaps are at an angle of 39° below the wing chord line.

Wing Flap Switch

An open guarded wing flap switch (20, figure 1-12), on top of the pilots' pedestal, has two marked positions, UP and DOWN, and is spring-loaded to an unmarked off position. When the switch is held to either of the operating positions, the solenoid-operated selector valve directs hydraulic pressure to the corresponding side of the hydraulic motor which operates the wing flaps. The flaps can be stopped at any intermediate position by releasing the wing flap switch.

Wing Flap Position Indicator

The wing flap position indicator (30, figure 1-7), is dc operated and is calibrated in degrees of flap extension.

Emergency Wing Flap Handle

The emergency wing flap handle (figure 1-32) is attached to the wing flap selector valve and is accessible through a door in the floor under the fifth window on the left side of the cabin. In the event of electrical failure of the wing flap control circuit the handle can be moved to either the FLAPS UP or FLAPS DOWN position to operate the wing flaps to the desired setting. The flaps stop when the handle is released to the neutral position. Inasmuch as the wing flap limit switches are inoperative, operation of the emergency wing flap handle must be coordinated with constant visual reference to the wing flap position indicator. Forcing the wing flap drive motor to continue trying to operate, after the wing flaps have reached the up or down limit stops, would impose undue torque stresses on the wing flap drive mechanism.

LANDING GEAR SYSTEM

The landing gear system is hydraulically operated. (See figure 1-30.) When retracted, the main gear units are completely contained within the nacelles and the nose gear unit is enclosed within the nose compartment. The nose gear fairing closes over the wheel well opening after the nose gear has been extended, but the main gear fairing doors remain open while the gear is extended. A small window in the flight compartment floor, aft of the pedestal, permits observation of the nose gear downlatch. The nose gear torque arms are provided with a quick-disconnect pin to facilitate ground handling of the airplane. Retraction time for the landing gear is less than five seconds; extension time is approximately 13 seconds.

Note

> The landing gear will extend and lock without the use of hydraulic pressure.

Landing Gear Lever

The landing gear lever (15, figure 1-12), located on the pilots' pedestal, has UP and DOWN positions. The lever is cable-connected to the main gear and nose gear up-latches and to the landing gear hydraulic selector valve. The landing gear lever latch (figure 1-34) in the upper end of the lever must be folded out to unlock the locking shaft before the lever can be moved from either the UP or DOWN position. If the locking shaft binds or fails, it can be unlocked by pulling out on the locking collar, on the base of the lever, and simultaneously moving the lever to the desired position. Access to the locking collar is gained by removing the side panel which covers the lower portion of the control lever. The lever itself is spring-loaded to the UP and DOWN over center positions. In addition, a spring-loaded safety lock inside the pedestal locks the landing gear lever in the DOWN position when the left main landing gear supports weight. This safety lock is released by a solenoid when the weight of the airplane is removed from the landing gear. A safety lock emergency release (figure 1-34) in the side of the pedestal is used to manually release the landing gear lever safety lock in the event of failure of the solenoid.

Note

> The landing gear lever can be moved to UP position before the weight of the airplane is

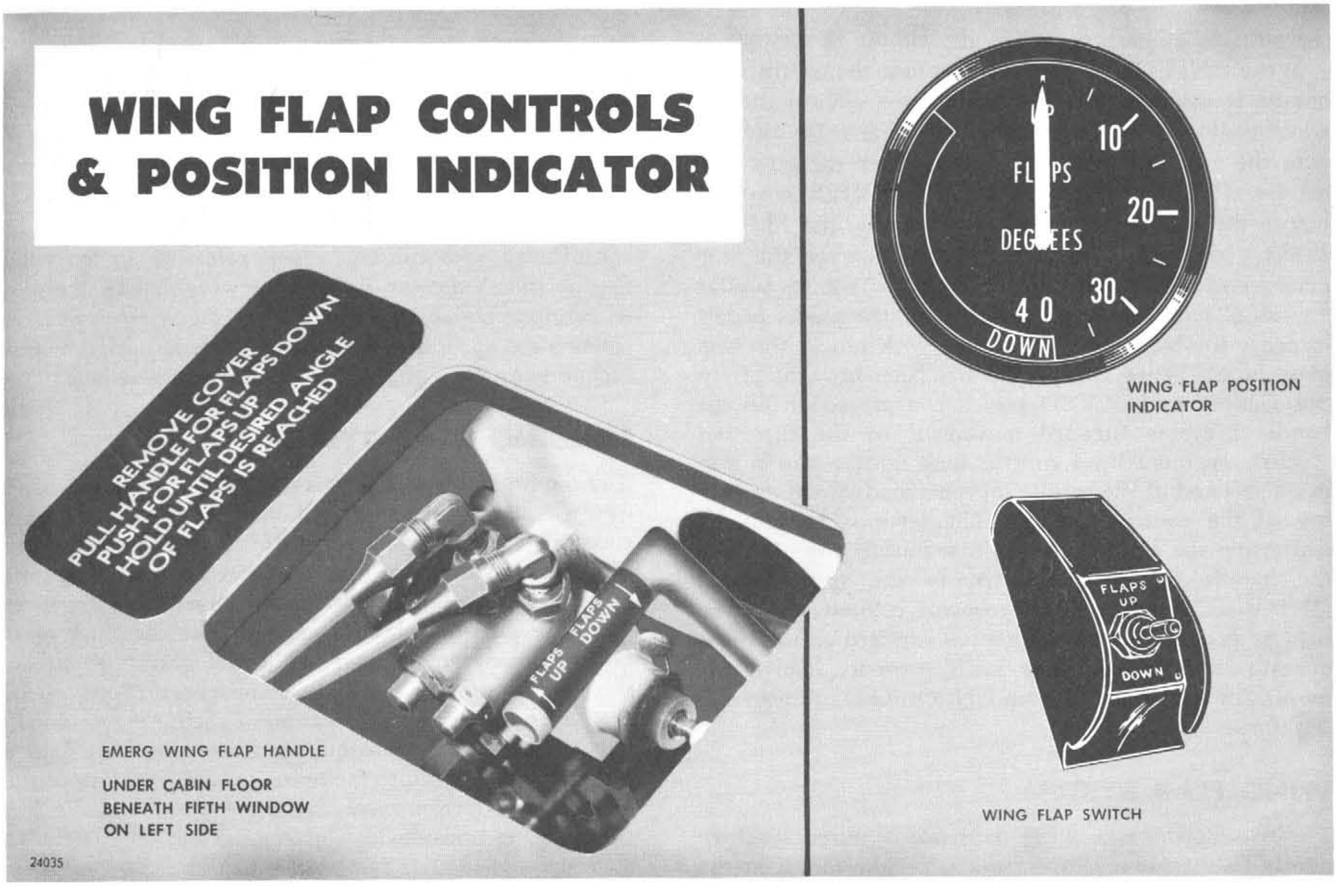


Figure 1-32

off the gear if the safety lock emergency release in the side of the pedestal is pushed in at the same time.

Emergency Landing Gear Up-Latch Release Knob

The emergency landing gear up-latch release knob (18, figure 1-6) has OFF and RELEASE positions. It is normally safety-wired to OFF. Should any of the up-latches fail to release the gear for extension, rotating the knob clockwise toward RELEASE position directs compressed air from the emergency air bottle to the up-latch release cylinders. The hydraulic pressure bypass handle should be in the BYPASS position to relieve system pressure and thus preclude binding of the landing gear up-latches when the emergency air system is used.

Landing Gear Ground Safety Locks

Pin-type ground safety locks (figure 1-33) are provided for both units of the main gear and for the nose gear. The pins are flagged with instructions to remove them before flight. They are stowed in the flight compartment.

Landing Gear Position Indicators

Three landing gear position indicators (23, figure 1-7), one for each gear, are located on the engine instrument panel. Each indicator has three electrically controlled tabs. There is an up-and-locked tab (marked UP), an unlocked or in-transit tab (heavy diagonal lines), and a down-and-locked tab (wheel). The landing gear position indicators are dc operated. In the event of power failure to the position indicators, the in-transit tab (heavy diagonal lines) will appear regardless of the gear position.

Landing Gear Unsafe Warning Light

A red landing gear unsafe warning light (21, figure 1-7) is located on the engine instrument panel below the gear position indicators. The light will illuminate when any one gear is not up-and-locked or down-and-locked. The light illuminates when the gear is in transit or if throttles are retarded to approximately 18 inches Hg manifold pressure when the landing gear is not down-and-locked. The light operates from the main dc bus and is controlled by the landing gear limit switches.

Landing Gear Warning Horn and Cutoff Switch

A landing gear warning horn is installed on the under side of the pilot's console. The horn blows if the throttles are retarded to a position corresponding to approximately 18 inches Hg manifold pressure while the landing gear is not down-and-locked. The horn can be silenced by momentarily holding the warning horn cutoff switch (14, figure 1-5) on the pilot's console in the OFF position. The switch is spring-loaded to ON but will not reactivate the horn until the system has been rearmed by moving the throttle forward past a position corresponding to 18 inches Hg. The horn operates on direct current from the main bus.

STEERING SYSTEM

The nose gear is equipped with a steering unit that is operated by hydraulic fluid from the nose gear "down" hydraulic line. Thus the steering unit is operative only when the landing gear lever is in DOWN position. A centering cam on the nose gear shock strut returns the nose wheels to centered position when the weight of the airplane is off the gear and the strut is not compressed, and the nose wheels are always centered when the gear is being extended or retracted. A quick-disconnect pin in the nose gear torque arm joint provides a means of freeing the nose wheels from the steering unit for ground handling purposes.

Steering Wheel

The steering wheel (12, figure 1-5) is on the pilot's console. The turning limit of the nose wheel is approximately 63° either side of center. The steering ratio is 4:1. When turning force is not being applied to the steering wheel, the steering control valve returns to neutral and the nose wheels are free to caster.

Turn Indicator

A turn indicator on the hub of the steering wheel indicates the amount and direction of turn of the nose wheels. The turn indicator is calibrated in degrees from zero to 60 in both directions from the centered position. A white alignment stripe is painted on the wheel and the console to indicate the centered position.

BRAKE SYSTEM

Each wheel of the main landing gear is equipped with a spot-type, single disc, self-adjusting brake. The brakes are normally operated by hydraulic pressure. An emergency air bottle provides pressure for operation of the brakes when hydraulic power is not available.

HYDRAULIC BRAKE SYSTEM

Hydraulic pressure from the hydraulic power supply system (figure 1-30) is metered at a maximum of 1000 psi to the brakes through valves operated by the brake pedals in the cockpit. Hydraulic pressure is always available, whether the hydraulic pressure bypass handle is in the BYPASS (UP) position or the PRESS (DWN) position. Automatic shuttle lockout valves in the brake system provide a hydraulic fuse. A shuttle piston inside each valve prevents hydraulic fluid from entering air lines and vice versa. The action of the valve is such that if the

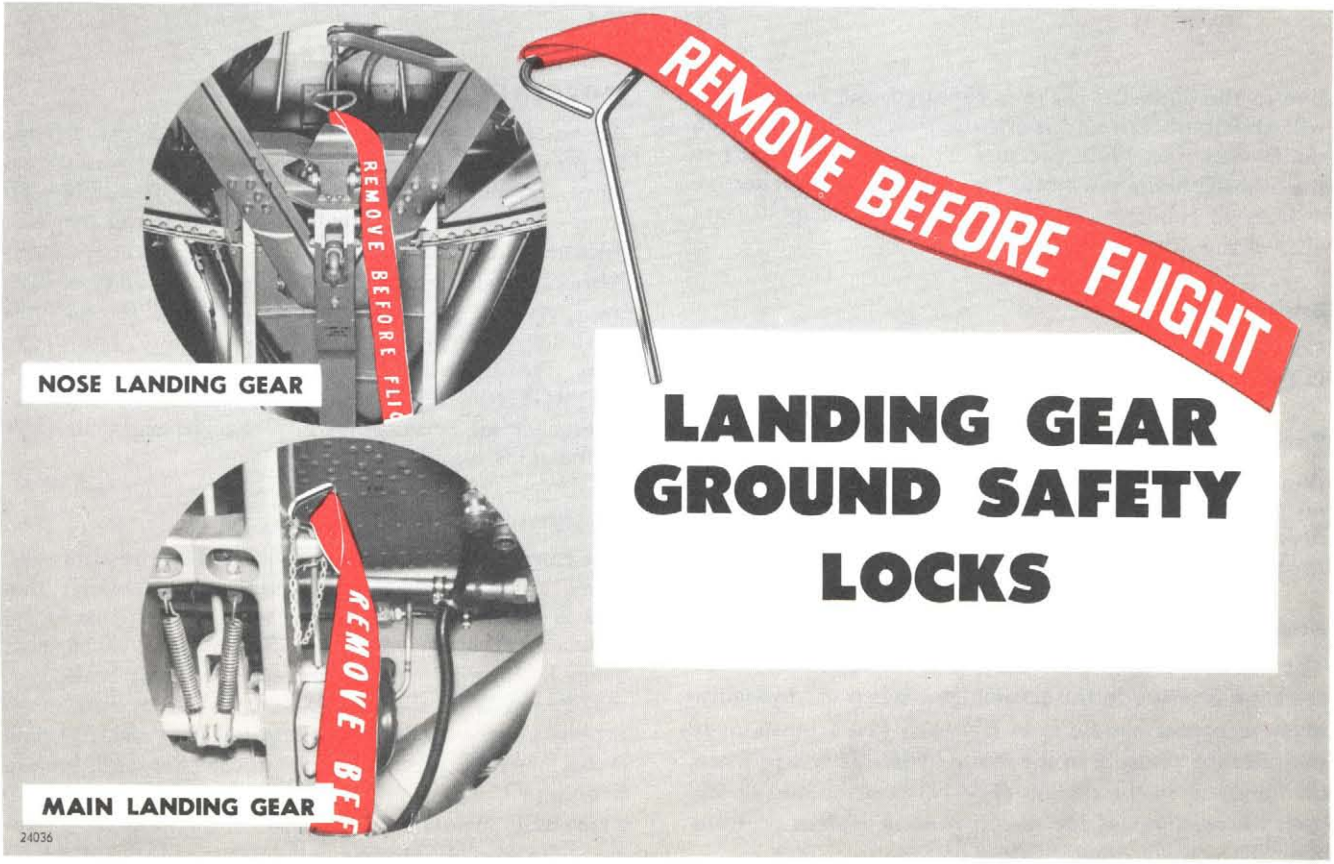


Figure 1-33

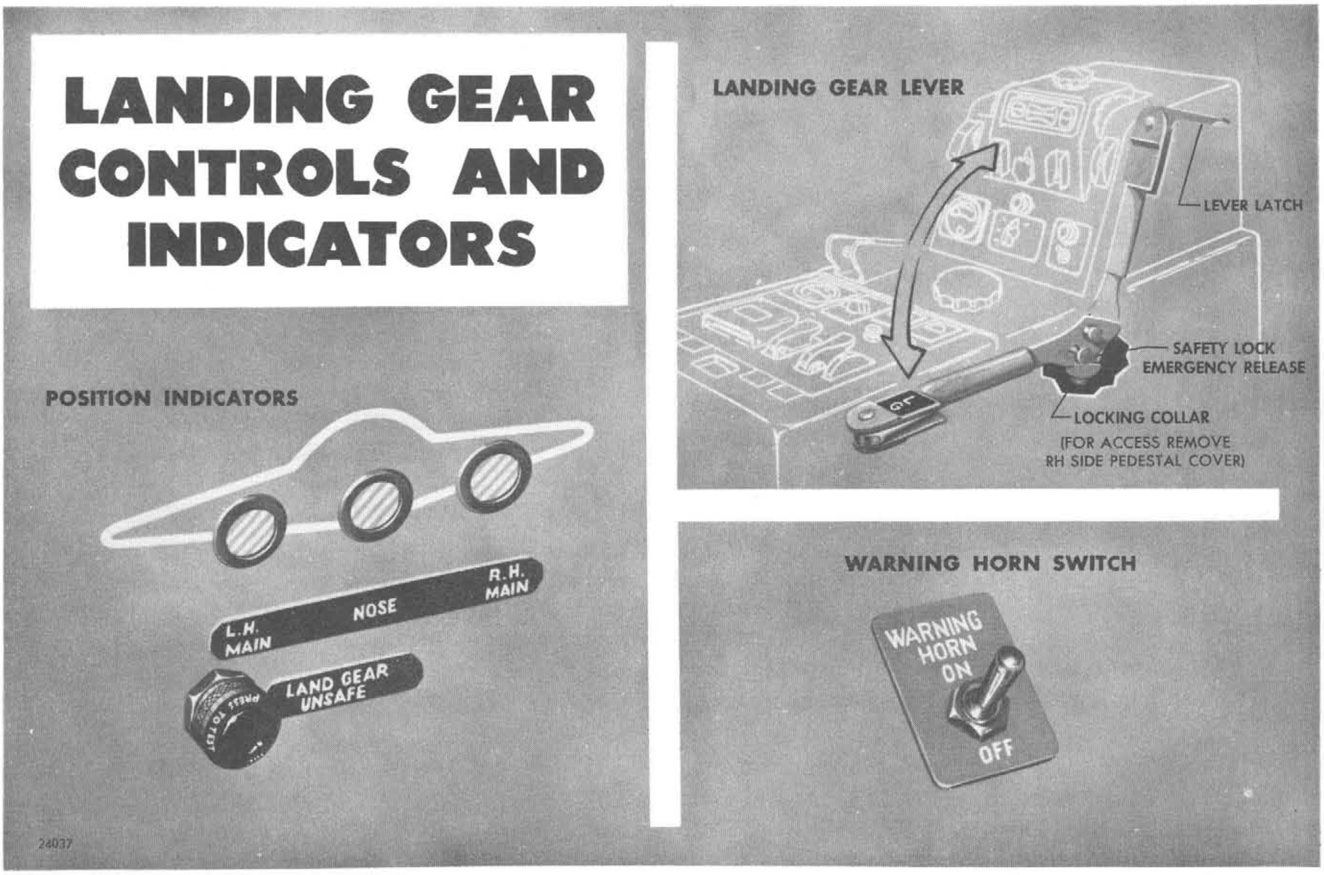


Figure 1-34

line to the outboard brake is ruptured, the fused piston will shift outboard and block the flow of fluid through the broken line. Fluid pressure will then be directed to the inboard brake assembly. The valve will be ineffective if lines to inboard and outboard brake assemblies are opened simultaneously.

Brake Pedals

Conventional toe-operated brake pedals are incorporated in the rudder pedals.

Parking Brake Handle

A parking brake handle (10, figure 1-5) is located on the pilots' console. The brakes must be applied by depressing the brake pedals before setting or releasing the parking brake handle.

Brake Hydraulic Pressure Gage

The brake hydraulic pressure gage (54, figure 1-7) indicates the pressure in the accumulator when the hydraulic pressure bypass handle is in BYPASS (UP) position. It indicates the pressure in the entire hydraulic system when the handle is in the PRESS (DWN) position and duplicates the readings of the main hydraulic system pressure gage. The gage is powered through a pressure transmitter by 26-volt regulated ac power.

EMERGENCY AIR BRAKE SYSTEM

An emergency air brake system (figure 1-35) provides air pressure for wheel braking if the brake hydraulic system is inoperative and reverse thrust is not available. The short section of tubing immediately preceding the brake discs must be intact for the air system to function properly. Although the system will allow varying degrees of braking pressure, the sensitivity of the system makes it extremely difficult to achieve this effect. The system does not provide for differential braking. (Refer to EMERGENCY AIR SYSTEM, this Section.) When the emergency air cylinder is fully charged eight air brake applications can be made.

Emergency Air Brake Knob

The emergency air brake knob, located on the pilot's console (11, figure 1-5), has OFF, ON, and HOLD positions and is normally safety-wired to the OFF position. A detent is provided at the HOLD position. When emergency braking is required, the emergency air brake knob may be moved to the HOLD position detent, then cycled rapidly toward the ON position, then OFF. Several rapid cycles may be required until the desired degree of braking is obtained. The knob may then be turned to HOLD, which will maintain that degree of braking with minimum drain of emergency air supply. Turning the knob back to the OFF position closes the emergency air line from the cylinder and releases pressure in the brake cylinders.

CAUTION

Hydraulic brake operation will not be reliable after emergency air brake operation until the brake hydraulic lines have been bled.

EMERGENCY AIR SYSTEM

An emergency air system (figure 1-35) is provided for emergency operation of the brakes and release of the landing gear uplatches. Air pressure is supplied by a compressed air cylinder mounted in the nose wheel well. The cylinder is serviced on the ground.

Emergency Air Pressure Gage

An air pressure gage (53, figure 1-7) is located on the copilot's shelf and indicates the pressure in the emergency air cylinder. Although the desired air bottle pressure is between 1450 and 2000 psi, the pressure may sometimes increase to 2500 psi due to heat expansion without adverse effect upon the emergency air system. See figure 1-40 for temperature corrections.

INSTRUMENTS

The pilot's and copilot's flight instruments are grouped on individual panels. The engine instrument panel is located between the two flight instrument panels (figure 1-7). All engine instruments except manifold pressure gage are electrically operated.

PILOT'S FLIGHT INSTRUMENTS

The pilot's and copilot's flight instrument panels (figure 1-7) are both provided with airspeed indicators, attitude indicators, autopilot directional indicators, magnetic indicators, altimeters, turn-and-slip indicators, and vertical velocity indicators. In addition, the pilot's flight instrument is provided with a course indicator and a directional indicator. A magnetic (standby) compass (6, figure 1-4) is located in the windshield "V."

Copilot's Attitude Indicator

One J-8 attitude indicator (43, figure 1-7) located on the copilot's flight instrument panel, provides visual indication of the pitch and roll of the airplane. The gyro motor of this instrument is operated by 115-volt ac power supplied by the inverter system. A knob at the lower right corner of the instrument allows manual erection of the gyro. If power fails during operation, a flag signal will show at the upper edge of the dial. However, a slight

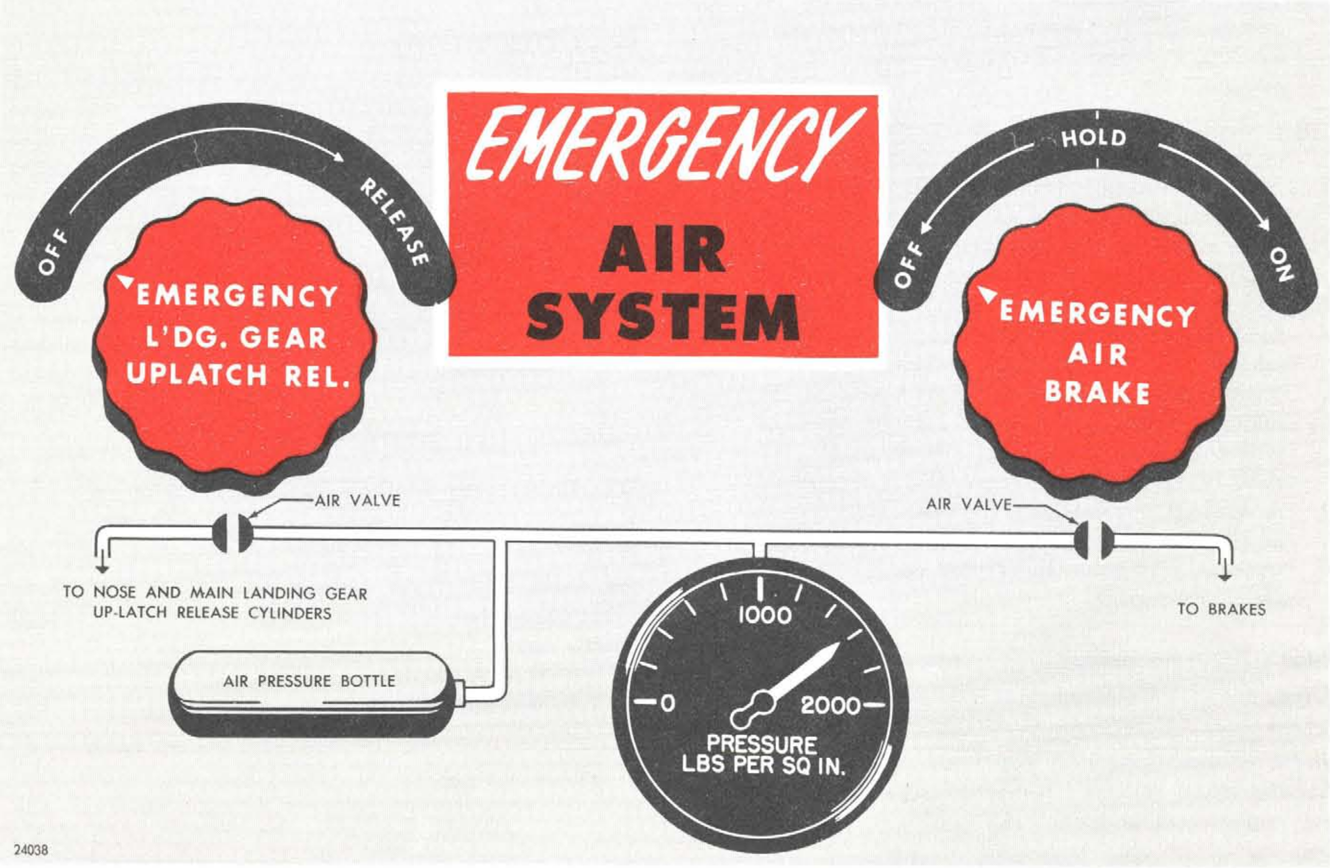


Figure 1-35

reduction in power or failure of certain electrical components within the system will not cause the flag to appear even though the system is not functioning properly. It is possible that a malfunction might be determined only by checking the attitude indicator with the directional indicator and the turn-and-slip indicator. Because of acceleration forces acting on the erection mechanism of the attitude indicator during a normal turn, errors in pitch and/or bank up to five degrees may be noted upon return to level flight. The indicator will immediately begin to correct these turn errors once true gravitational forces are sensed. The attitude indicator gyro must erect in order to indicate correctly.

CAUTION

To avoid damage to the instrument do not pull the erection knob violently. The indicator cages to the attitude of the airplane and not to the true vertical. Therefore, the instrument should never be caged to correct inflight errors unless the airplane is in straight and level flight by visual reference to a true horizon.

WARNING

- To avoid the possibility of takeoff with the J-8 attitude indicator erected in the inverted position, cage it prior to takeoff to insure proper erection.
- A slight amount of pitch error in the indication of the attitude indicator will result from accelerations or decelerations. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the takeoff run. At this time, a climb indication error of about 1½ bar widths will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each takeoff. These errors should be recognized as normal and the instrument should be allowed to correct itself. The erection system will automatically remove the error after the acceleration ceases.

Pilot's Attitude Indicator

A type MM-1 attitude indicator (5, figure 1-7) is installed on the pilot's flight instrument panel. This instrument is similar in appearance and operation to the type J-8 except that the MM-1 indicator incorporates an automatic erection system that maintains the gyro rotor in the erect position at all times regardless of the attitude of the airplane. A single knob at the lower right corner of the instrument provides manual adjustment of the horizon bar. A power failure signal flag will show if the power supply is interrupted or the indicator is not operating.

AC Gyro Instrument Power Cutoff Switch

An ac gyro instrument cutoff switch (18, figure 1-4) is installed on the lower edge of the main circuit breaker panel. The switch has ON and OFF positions. When placed in the ON position, the gyros for the attitude and directional indicators are connected to a 115-volt regulated ac bus. When placed in the OFF position, the gyros are disconnected from the bus. The switch is normally left in the ON position. It is primarily used to disconnect the gyros from the bus during ground maintenance of the airplane when the inverters are operating to prevent operation and undue wear of the gyros. A red indicator light, located adjacent to the switch, will illuminate when the switch is in the OFF position. The light operates from the main dc bus.

PILOT'S PITOT STATIC SYSTEM

The pilot's and copilot's pitot systems (figure 1-36) are independent, and each receives pitot pressure from a separate pitot tube installed on the nose of the fuselage. Static pressure from a pair of external static ports located on the sides of the fuselage, and from the alternate static ports in the dorsal fin, are available for the pilot's and copilot's flight instruments.

Static Pressure Selector Valves

A static pressure selector valve (8, figure 1-5 and 1, figure 1-6) is installed on each of the auxiliary panels outboard of the pilot's and copilot's flight instrument panels. The valves are used to select static pressure from either the two side ports or the alternate dorsal fin port. At cruising airspeeds, the altimeter reading will be approximately the same for either static port setting. As speed is reduced, the altimeters will read progressively lower when the alternate (dorsal fin) port is used, until at minimum airspeeds, the reading is approximately 50 feet lower than the normal reading.

EMERGENCY EQUIPMENT

FIRE DETECTION AND EXTINGUISHER SYSTEMS

A fire detection system warns of fire in the nacelles and in the area of the reserve oil tank below the floor opposite the rear loading door. A fixed dibromodifluoromethane fire extinguisher system is provided for extinguishing nacelle fires.

FIRE DETECTION SYSTEM

A thermocouple-type fire detection system detects fires in the following zones: engine sections, engines accessory sections, main landing gear wells, and reserve oil tank area. Two overlapping fire detection circuits are installed in each nacelle ("A" & "B" circuits), and additional detection circuits are installed in the reserve oil tank

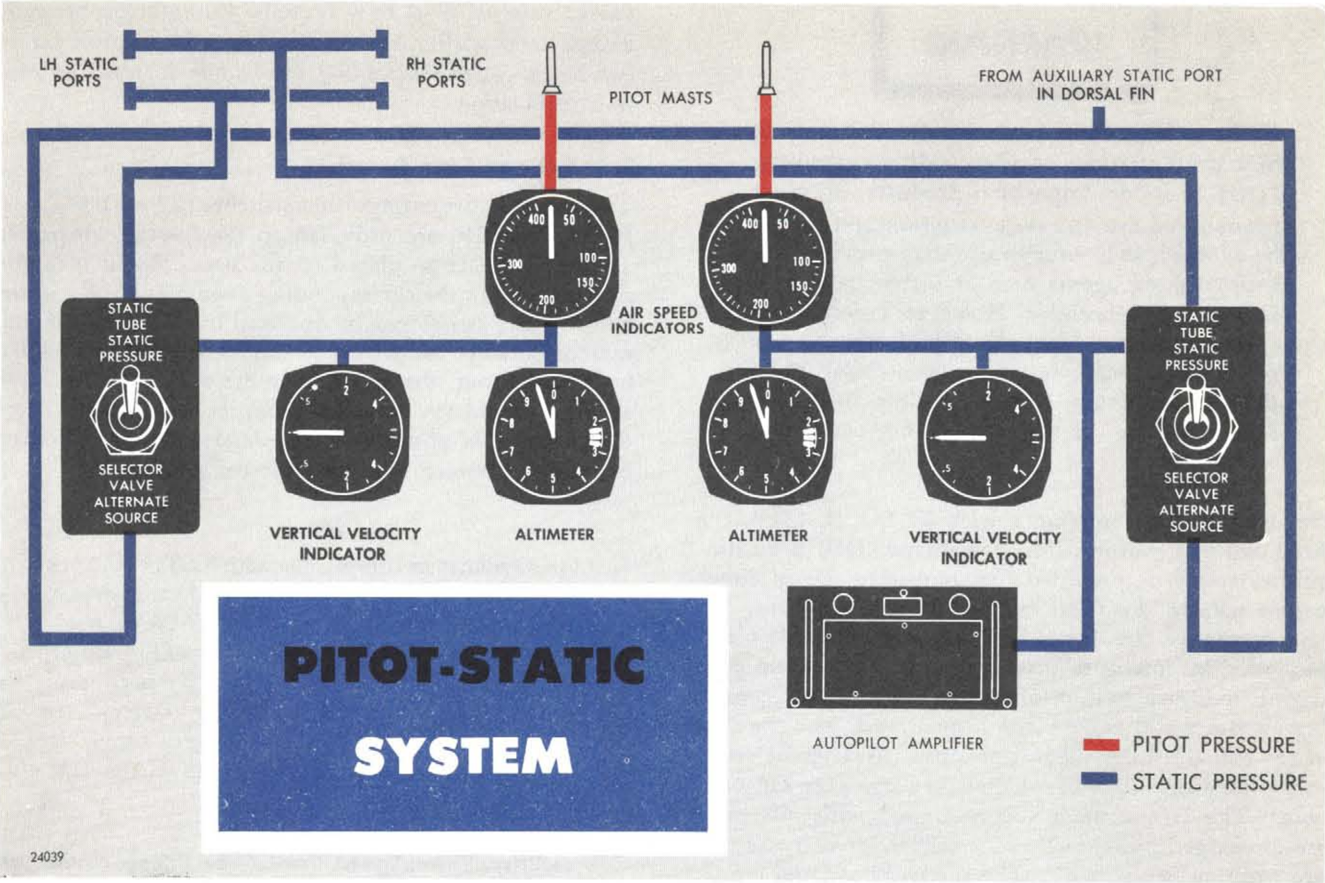

LH STATIC PORTS
RH STATIC PORTS
PITOT MASTS
FROM AUXILIARY STATIC PORT IN DORSAL FIN
STATIC TUBE STATIC PRESSURE
SELECTOR VALVE ALTERNATE SOURCE
AIR SPEED INDICATORS
VERTICAL VELOCITY INDICATOR
ALTIMETER
ALTIMETER
VERTICAL VELOCITY INDICATOR
STATIC TUBE STATIC PRESSURE
SELECTOR VALVE ALTERNATE SOURCE
PITOT-STATIC SYSTEM
AUTOPILOT AMPLIFIER
🟥 PITOT PRESSURE
🟦 STATIC PRESSURE
24039

Figure 1-36

area. A test system is provided to check operation of the detection system. Fire can be detected in three zones of each nacelle: the engine section, the accessory section, or the wheel well area. Extinguishing agents, when discharged to a nacelle, enter only the accessory section and the wheel well area.

Fire Detection Circuit Test Switch

A toggle switch is provided on the fire control panel (figure 1-37) to test all components and circuits of the fire detection system. The switch has three positions: DET "A" L & R NAC & FUS OIL (toggle left position), DET "B" L & R NAC (toggle right position), and an unmarked off position to which the toggle is spring-loaded. Holding the switch in the toggle left position will cause all three fire warning lights on the fire control panel to come on if there is no defect in the "A" circuits or the fuselage circuit. Holding the switch in the toggle right position will cause the "NO. 1 ENGINE" and "NO. 2 ENGINE" fire warning lights to come on if there are no defects in the "B" circuits.

Fire Warning Lights

Three fire warning lights (figure 1-37), on the fire control panel, illuminate to display: "NO. 1. ENGINE," "NO. 2 ENGINE," and "FUS OIL TANK." Illumination of one of the warning lights indicates that at least one thermocouple in the corresponding area has sensed the sudden increase of heat characteristic of flame. The gradual heat increase normal to engine operation usually does not energize detector thermocouples. A warning light that has illuminated to indicate fire will go out when fire is no longer present in the area.

WARNING

If the detection circuit is broken by fire damage, the light will go out before the fire is out.

ENGINE FIRE EXTINGUISHER SYSTEM

On some airplanes a fixed, one-shot dibromodifluoromethane (DB) fire extinguisher system is provided for combating one fire in either engine nacelle. Two fire extinguishing agent containers, located in the left wing fillet, are connected by tubing to discharge points located in the following areas in each nacelle: accessory section, carburetor, alternator and generator, oil cooler, and main landing gear well. The pressure of the extinguishing agent is also used to close the accessory compartment air outlet door in the engine top cowl panel. The two containers, pressurized with nitrogen, are discharged simultaneously and completely in approximately three seconds. The discharge circuits are dc powered.

WARNING

Prolonged exposure (five minutes or more) to high concentrations of dibromodifluoromethane (DB) or its decomposition products can cause pronounced eye and nose irritation and should be avoided. It is safer to use than previous fire extinguishing agents such as carbon tetrachloride or methylbromide. However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

On airplanes in compliance with TCTO 1C-131-521 a fixed two-shot dibromodifluoromethane (DB) fire extinguisher system is provided for combating fire in either engine nacelle. Two DB containers, one main and one reserve supply, are located in the left wing fillet and connected by tubing to discharge points located in each engine accessory section, alternator and generator cooling air ducts and main landing gear well. The pressure of the extinguishing agent is also used to close the accessory compartment air outlet door in the engine top cowl panel. The DB containers (pressurized with nitrogen) are discharged individually by a selector switch and two fire extinguisher switches. The discharge circuits are dc powered from the emergency bus.

Fire Extinguisher Selector Switch (Airplanes in Compliance with TCTO 1C-131-521)

A selector switch on the fire control panel (figure 1-37) has MAIN and RESERVE positions. Placing the selector switch to the desired position arms the fire extinguisher switches which, when actuated, will discharge the selected DB bottle to the appropriate nacelle.

Fire Extinguisher Supply Indicator Lights (Airplanes in Compliance with TCTO 1C-131-521)

Two indicator lights adjacent to the DB selector switch indicate "MAIN DB SUPPLY OUT" or "RESERVE DB SUPPLY OUT." When either the main or reserve bottle is discharged, the corresponding light will illuminate and remain on until the bottle is recharged and the pressure switch reset. There are four pressure switches, two in each section of the system, mounted in the wing fillet aft of the DB containers. Once the discharge lights on the fire control panel are illuminated, they will remain on until the pressure switches have been reset manually after the system has been purged and serviced for future use.

Engine Fluid-Off Handles

Two engine fluid-off handles (figure 1-37), one for each engine, are provided on the fire control panel for the purpose of mechanically shutting off the flow of fuel, oil, and hydraulic fluid to either engine area in the event of fire. When one of these handles is pulled out, shutoff valves stop all fluid flow forward through the firewall, except the propeller feathering oil line. The shutoff valves can be reopened by pushing the handle forward into its normal position.

Fire Extinguisher Switches

Two guarded fire extinguisher switches (figure 1-37), one for each nacelle, are provided on the fire control panel. The switches are so placed on the panel that it is necessary to pull out the corresponding engine fluid-off handle before a fire switch can be operated to discharge the fire extinguisher system. After the engine fluid-off handle has been pulled out, the guard over the fire switch is lifted and the fire switch is moved from its normal OFF position to the ON position to completely discharge the fire extinguisher system into the selected nacelle.

Note

On airplanes in compliance with TCTO 1C-131-521, the DB fire extinguisher selector switch must be at either the MAIN or RESERVE position in order to arm the fire extinguisher switches. If the MAIN supply has been discharged, placing the selector switch to RESERVE will discharge the reserve supply if the fire extinguisher switch is held in the ON position.

Fire Extinguisher Agent Container Pressure Gages

Two pressure gages on the fire extinguishing agent containers (figure 1-38) register the pressure within the containers. The gages are accessible through an access door in the lower surface of the fillet between the left wing trailing edge and the fuselage.

Note

The containers are charged to 400-440 psi at 21°C (70°F). At lower temperatures the gage pressure is reduced and at higher temperatures the gage pressure will read higher. To determine that the containers are properly charged correct the gage pressure reading by adding or subtracting one psi per 1°F above or below 70°F. (See figure 1-40.)

PORTABLE FIRE EXTINGUISHERS

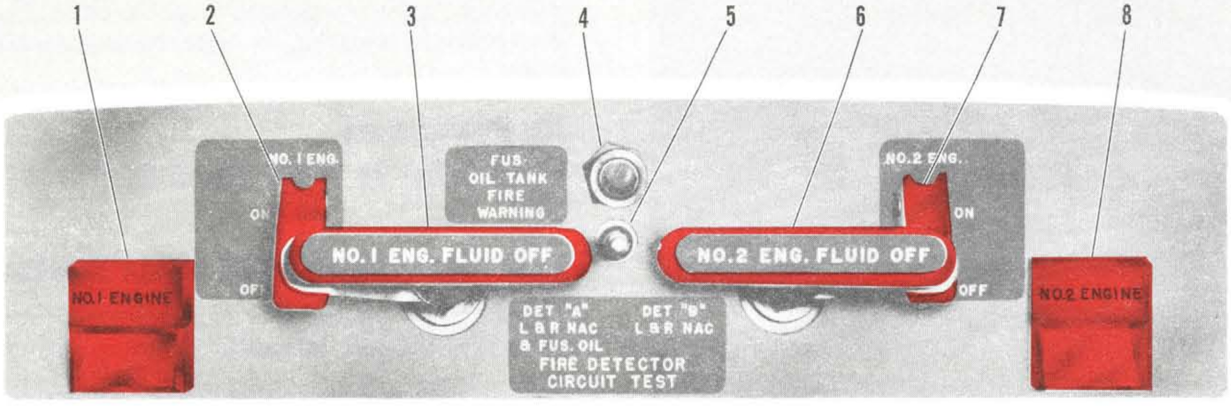
A one-quart CB portable fire extinguisher (13, figure 1-4) is located aft of the copilot's seat. Two one-quart CB portable fire extinguishers (figure 3-3) are located in the cabin. A pressure gage on each extinguisher indicates the nitrogen and CB pressure in the extinguisher.

WARNING

Repeated or prolonged exposure to high concentrations of bromochloromethane (CB) or

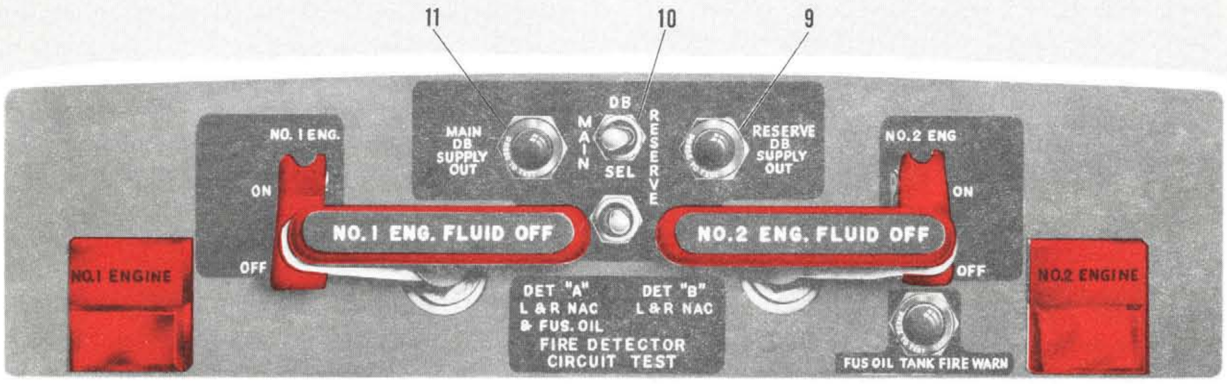
FIRE CONTROL PANEL

AIRPLANES NOT IN COMPLIANCE WITH T.O. 1C-131-521



1. No. 1 Engine Fire Warning Light
2. No. 1 Engine Fire Switch
3. No. 1 Engine Fluid-Off Handle
4. Fuselage (Reserve) Oil Tank Fire Warning Light
5. Fire Detector Circuit Test Switch
6. No. 2 Engine Fluid-Off Handle
7. No. 2 Engine Fire Switch
8. No. 2 Engine Fire Warning Light
9. Reserve DB Supply-Out Warning Light
10. Fire Extinguisher Selector Switch
11. Main DB Supply-Out Warning Light

AIRPLANES IN COMPLIANCE WITH T.O. 1C-131-521



FIRE DETECTION AND EXTINGUISHER ZONES

▨ DETECTION ONLY

▨ DETECTION AND EXTINGUISHING

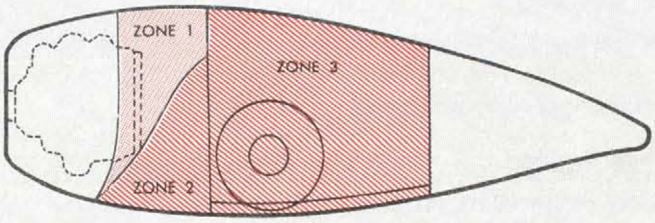


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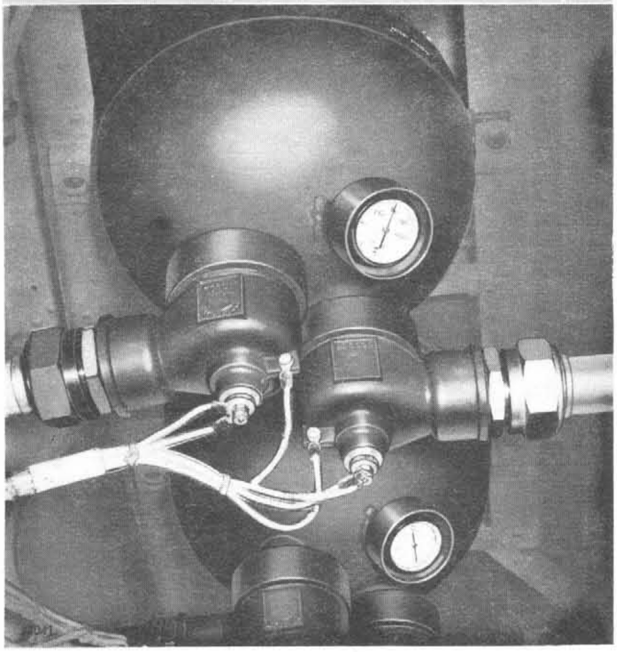
Figure 1-37



FIRE EXTINGUISHER CONTAINERS AND PRESSURE GAGES

Figure 1-38

decomposition products should be avoided. CB is a narcotic agent of moderate intensity but of prolonged duration. It is considered to be less toxic than carbon tetrachloride, methyl bromide, or the usual products of combustion. In other words, it is safer to use than previous fire extinguishing agents. However, normal precautions should be taken, including the use of oxygen when available.

FLASHLIGHTS

Flashlights (figure 3-3) are installed opposite the main entrance door, the rear loading door, and each cabin emergency exit. They are of the impact type, lighting upon sudden deceleration to illuminate the exits. The flashlights may be removed from their holders and operated manually if desired.

FIRST AID KITS

Two first aid kits are provided. One kit is installed in the crew locker and one kit is installed on the wall of the cabin opposite the litter loading door.

ESCAPE CHUTE

A fabric escape chute for emergency ground evacuation of personnel is installed on the inner side of the litter-loading door. To arm the chute, snap it onto the two overhead and the two floor rings before jettisoning or opening the door. The chute will automatically release. The lower end of the chute should be pulled tight and held by personnel on the ground.

ESCAPE ROPE

An escape rope is provided adjacent to the aft escape hatch on the right side of the cabin to aid in the emergency evacuation of personnel from the cabin. The rope is accessible by removing the right rear emergency escape hatch.

EMERGENCY EXITS

See figure 3-11 for location and operation of emergency exits.

ENTRANCE DOOR AND STAIR SYSTEM

The entrance door and stair (figure 1-39), in the right side of the fuselage, forward of the wing, are normally extended and retracted hydraulically. Hydraulic pressure for operation of the door and stair is supplied from the landing gear "down" hydraulic line, and the door and stair can be operated hydraulically only when the landing gear lever is in DOWN position.

Entrance Door Operating Handle

An entrance door and stair operating handle (figure 1-39) is provided on the entry forward bulkhead. The handle, which slides vertically on a slotted panel, has two marked positions: OPEN (down), and CLOSE (up), and a neutral unmarked position provided with a detent. The handle is mechanically connected to the entrance door hydraulic selector valve. When the handle is moved to OPEN position, it turns the valve and routes hydraulic pressure to the door opening port of the door and stair actuating cylinder. The opposite action takes place when the control is moved to CLOSE position. The door and stair open or close through a metering action in approximately seven seconds. The operating handle is normally left in OPEN position while the door is open and is held in CLOSE position to close the door and stair; it is then placed in the neutral detent until the next operation. When the handle is in neutral, hydraulic pressure in the actuating cylinder is relieved.

Primary Lock Lever

The primary lock lever (figure 1-39), on the entry aft bulkhead, mechanically operates the primary latches that hold the door closed.

Secondary Lock Control

A sliding secondary lock control (figure 1-39), on the entry aft bulkhead, mechanically operates pins that slide into the door latch hooks to hold them in locked positions. The secondary lock control has two positions, LOCK and OPEN.

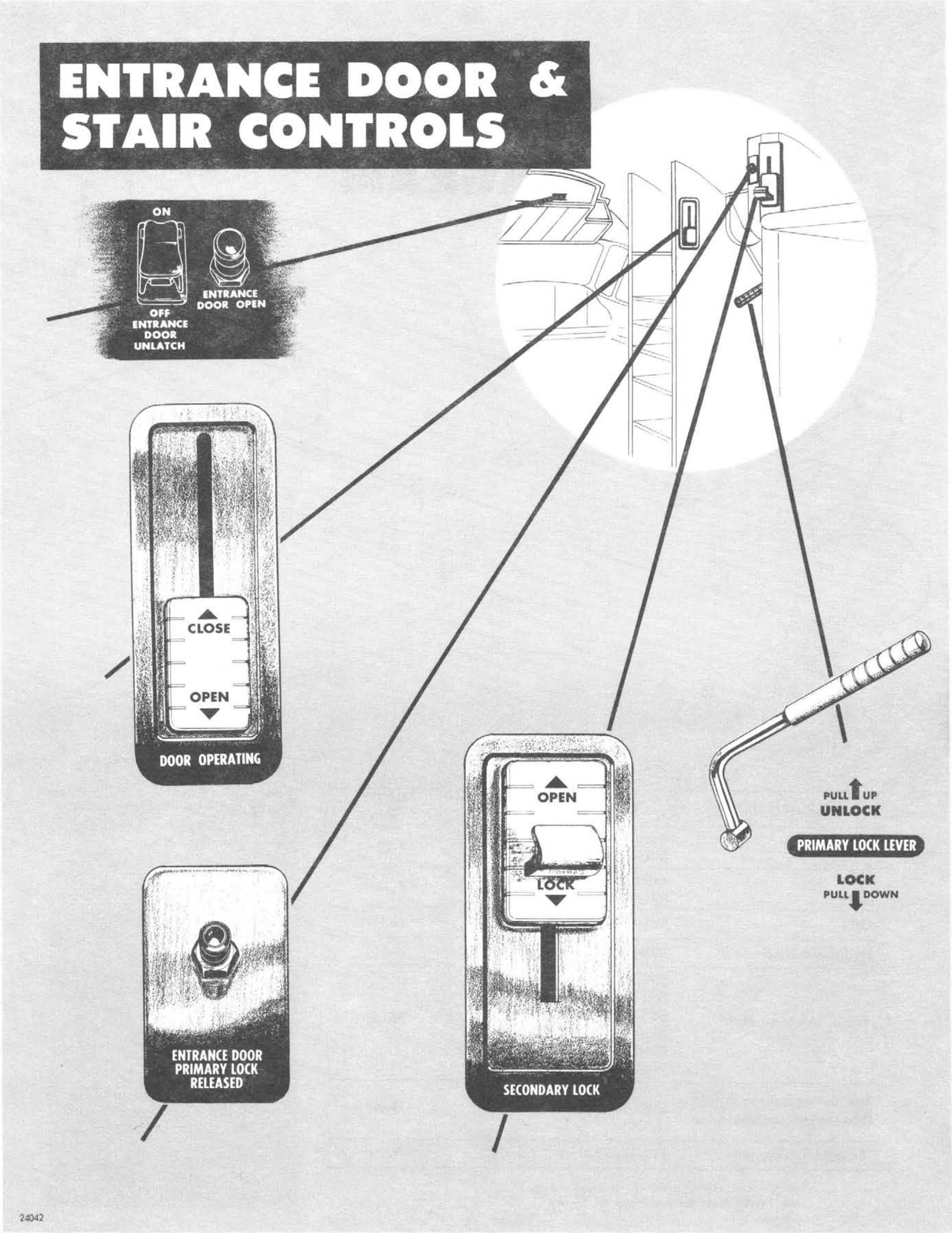
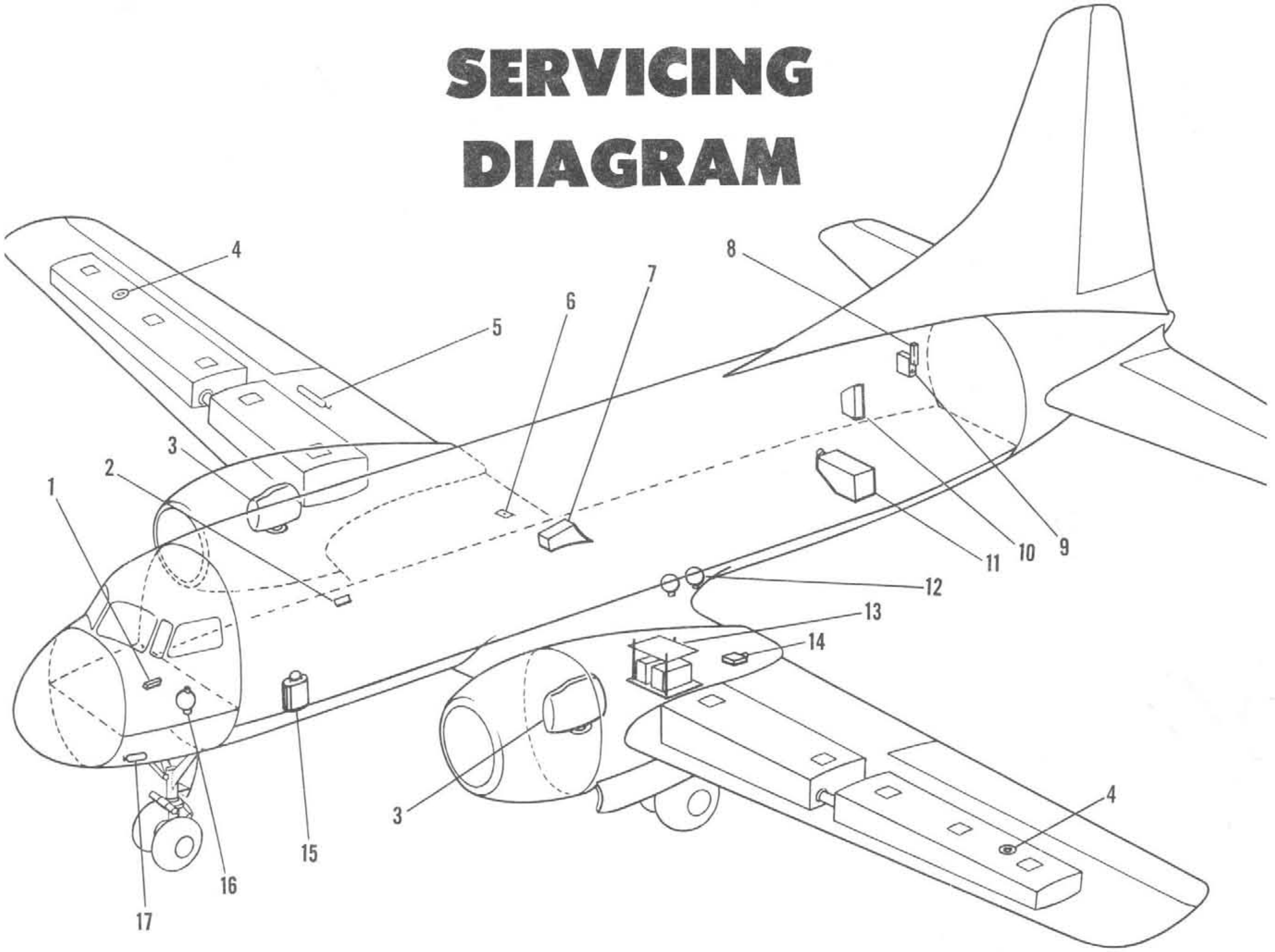

ENTRANCE DOOR & STAIR CONTROLS
ON
OFF ENTRANCE DOOR UNLATCH
ENTRANCE DOOR OPEN
CLOSE
OPEN
DOOR OPERATING
ENTRANCE DOOR PRIMARY LOCK RELEASED
OPEN
LOCK
SECONDARY LOCK
PULL UP UNLOCK
PRIMARY LOCK LEVER
LOCK PULL DOWN
24042

Figure 1-39

SERVICING DIAGRAM



SERVICE FLUID	USAF SPECIFICATION	NATO SYMBOL
Fuel*	Recommended MIL-G-5572 Grade 115/145	F-22
	Alternate MIL-G-5572 Grade 100/130	F-18
Oil	MIL-L-6082 Grade 1100	O-117
Hydraulic Fluid	MIL-H-5606	H-515
Water Injection Fluid	50% Methyl Alcohol OM 232 Grade A 50% Distilled Water By Volume And MIL-C-4339 In The Amount Of 2/3 Of 1% Of The Water	None
Fire Extinguishing Agent Dibromodifluoromethane	MIL-D-4540	None
Breathing Oxygen	MIL-O-27210	None

*When Fuel Grade 100/130 is Used – Engine Power Must Be Restricted As Shown in Section V.

1. External Power Receptacles
2. Oxygen System Filler Valve
3. Engine Oil Tanks
4. Fuel Tank Filler Caps
5. Alternator Generator Hydraulic System Servicing Panel
6. Cabin Pressurization Compressor Sump
7. Water Injection Tank
8. Paper Cup Dispenser
9. Drinking Water Tank
10. Lavatory Water Tank (11 Gallons)
11. Reserve Oil Tank
12. Fire Extinguisher Agent Containers
13. Batteries
14. Dehydrator Container (Marker Beacon Antennas)
15. Main Hydraulic System Reservoir
16. Main Hydraulic System Accumulator
17. Emergency Air Bottle

24043-1

Figure 1-40

TEMPERATURE CORRECTION TABLE

STABILIZED TEMPERATURES ●		PSI AT VARIOUS TEMPERATURES				
		ENGINE FIRE EXTINGUISHER ●		OXYGEN SYSTEM ●	EMERGENCY AIR SYSTEM ●	MAIN HYDRAULIC ACCUMULATOR
°C	°F	MIN.	MAX.	TOLERANCE ±25	TOLERANCE $^{+0}_{-550}$	TOLERANCE ±20
71	160			497	2450	1202
65	150			489	2400	1180
60	140			481	2350	1158
55	130			473	2300	1135
49	120			465	2250	1113
43	110	440	505	457	2200	1091
38	100	425	490	449	2150	1068
32	90	410	475	441	2100	1046
26	80	400	465	433	2050	1023
21	70	390	455	425	2000	1000
16	60	380	445	417	1950	977
10	50	370	435	409	1900	955
5	40	360	425	401	1850	932
−1	30	350	415	393	1800	910
−7	20	340	405	385	1750	887
−12	10		395	377	1700	865
−18	0		385	369	1650	842
−24	−10			361	1600	819
−29	−20			353	1550	796
−34	−30			345	1500	773
−40	−40			337	1450	750
−45	−50			329	1400	728
−51	−60			321	1350	705
−54	−65			313	1300	694

The above table illustrates pressure changes in some pressurized systems at various stabilized ambient temperatures. System pressures should correspond to the pressure indicated in the table for any given ambient temperature with allowance for the tolerance given for each system. The tolerances given are based on a 70°F stabilized temperature.

The figures are theoretical and for all practical purposes when used in servicing and inspection, the numbers may be rounded out to the nearest 5 psi. In checking accumulator and air bottle pressures on the airplane, consideration must be given to variations of temperature within and surrounding certain components of the airplane. Cockpit temperatures of an airplane setting in the sun may be as much as 20°F higher than the OAT.

24043-2

Entrance Door Unlatch Switch

The guarded entrance door unlatch switch (figure 1-39), on the overhead switch panel, has ON and OFF positions. It is spring-loaded and guarded to OFF. When the switch is OFF, two spring-loaded lock pins prevent inadvertent withdrawal of the primary latches from the locked position. When the switch is held to ON, two dc operated solenoids withdraw the lock pins and the green light at the door glows to indicate that latches can be opened. The lock pins cannot be mechanically withdrawn from inside the airplane; therefore, 28-volt dc power is required to open the entrance door from inside the airplane.

Exterior Secondary Lock Handle

An exterior secondary lock handle (figure 2-1), located in a recess in the skin below the entrance door, is pulled to release the secondary lock pins from the primary latches, when opening the door from the outside.

Exterior Primary Lock Handles

The two primary latches can be mechanically engaged or released from the outside (even when mechanically and electrically locked from the inside) by means of two handles (figure 2-1) on the exterior latch plates.

Entrance Door Primary Lock Release Indicator Light

A green indicator light (figure 1-39), located adjacent to the secondary lock control, illuminates when the solenoid lock pins are withdrawn from the latches by operation of the entrance door unlatch switch. When the light is on, the door can be unlocked and opened from inside.

Door-Open Warning Light

The door-open warning light (figure 1-39) on the overhead switch panel is operated by microswitches at the entrance door, rear door, and lower forward compartment door. If any of these doors is not closed and latched the light will be on. The door-open warning light circuit is dc powered.

FLIGHT COMPARTMENT SEATS

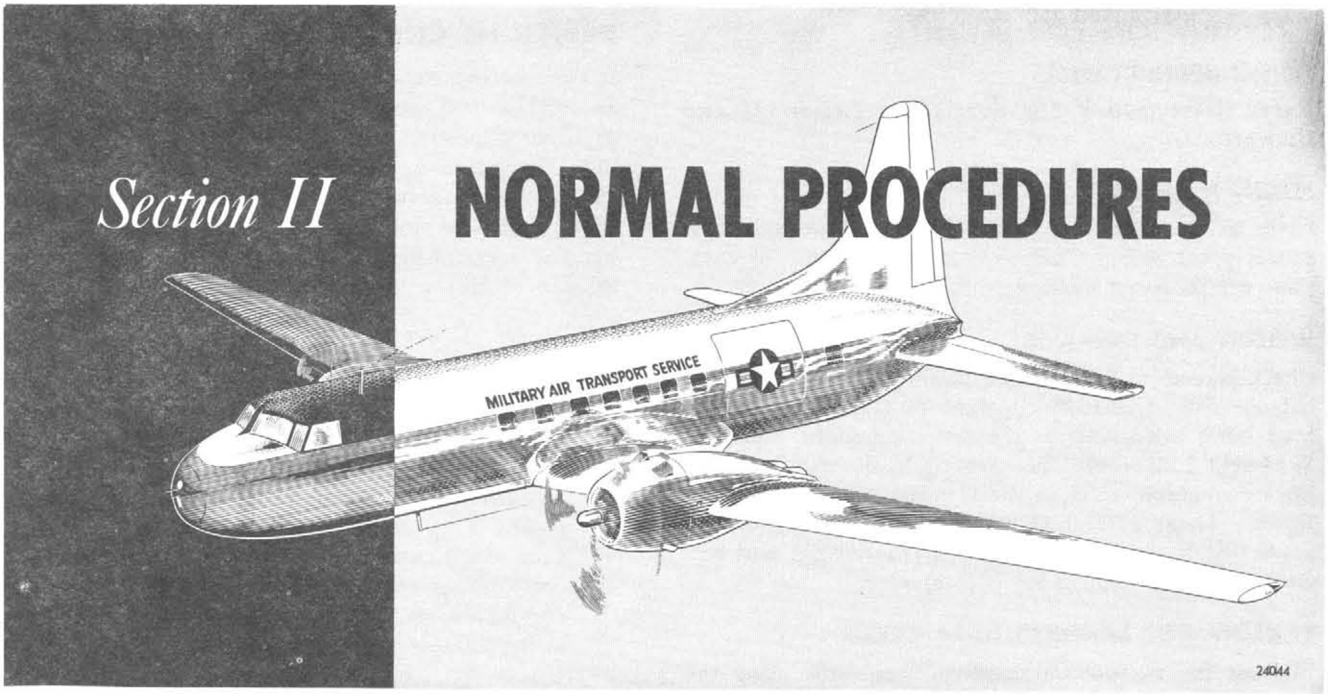
PILOTS' SEATS

The pilot's and copilot's seats are mounted on tracks. A small handle, below the forward edge of each seat, is pulled up to release the seat for fore-and-aft adjustment; when the seat is in the desired position, the handle is released to lock the seat in place. A lever on the outboard side of each seat is pulled up to release the seat for vertical adjustment; releasing the lever locks the seat in the desired position. A small thumb lever, on the outboard rear support tube of each seat, is pressed down to release the seat-back in the desired degree of tilt. Both armrests of each seat can be moved upward to stowed positions. Safety belts and shoulder harnesses equipped with inertia reels are installed at each seat.

AUXILIARY EQUIPMENT

Section IV of this manual contains information on the following auxiliary equipment: air-conditioning, defrosting, anti-icing and de-icing, communication and associated electronic equipment, lighting, oxygen, automatic pilot, and miscellaneous equipment.

Section II NORMAL PROCEDURES



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PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

Refer to Section V for operating restrictions and limitations.

FLIGHT PLANNING

Refer to the Appendix to determine the fuel quantity, power plant settings, airspeeds, etc., necessary to complete the proposed mission.

WEIGHT AND BALANCE

Check takeoff and anticipated landing gross weight and balance data. Check that weight of fuel and alternate load items are suited to the proposed flight. Refer to WEIGHT LIMITATIONS, Section V. For detailed loading information, refer to the Handbook of Weight and Balance Data, T. O. 1-1B-40, and to the load adjuster applicable to this airplane. Check that weight and balance clearance, Form 365F, is completed.

TAKEOFF AND LANDING DATA CARDS

Fill out the takeoff and landing data cards using the operating data in the Appendix. These cards are in the Pilots' Abbreviated Flight Crew Checklist, T. O. 1C-131A-CL-1-1. Takeoff and landing data are required for all flights. However, go-no-go marker no/time, and go-no-go airspeed (KIAS), are not required when refusal speed is greater than takeoff speed. These items should be computed, however, if the runway is covered with ice, snow, or slush. Single-engine ceiling (METO power) need be computed only if terrain may be a factor in the event of engine failure after takeoff.

CHECKLISTS

The Flight Manual now contains only amplified checklists. The abbreviated checklists have been issued as separate technical orders. T.O. 1C-131A-CL-1-1 contains normal procedures, emergency procedures, and performance data, for use by a basic crew of pilot, copilot, and flight mechanic. A flight deck coordinator is installed in the cockpit on some airplanes for use of scroll type checklists of cockpit procedures. The scroll checklist, T.O. 1C-131A-CL-1-1-1, covers only normal procedures from BEFORE STARTING ENGINES to BEFORE LEAVING AIRPLANE. Refer to checklists in the Flight Manual foreword.

Note

The term "climatic" as used in the checklists indicates equipment operation or settings which may be necessary for other than daylight VFR conditions. This includes IFR, night, cold weather, tropic, and desert conditions. The equipment operation or setting will vary depending on the prevailing conditions. In practice, the response to climatic items will be the required switch or control position.

ENTRANCE

See figure 2-1.

PREFLIGHT CHECKS

It shall be the responsibility of the pilot to ensure that an interior and exterior inspection, as outlined, and a preflight inspection, as required by the Manual of Scheduled Inspection and Maintenance Requirements, T. O. 1C-131A-6, have been performed. It shall also be the responsibility of the pilot to ensure that each crew member has accomplished his individual inspection requirement as outlined in this Section and in Section VIII.

Note

- The aircrew visual inspection procedures outlined in this Section are predicated on the assumption that maintenance personnel have completed all the requirements of the manual of Scheduled Inspection and Maintenance Requirements, T. O. 1C-131A-6, for preflight. Therefore, duplicate inspections and operational checks of systems by aircrew members have been eliminated, except for certain items required in the interest of flying safety.
- THRU-FLIGHT checklist. The thru-flight checklist is to be accomplished only when the airplane is assigned missions which require intermediate stops by the same flight crew and no maintenance is performed during these stops. Thru-flight checklist items are indicated by an asterisk (*). These items must be accomplished during an intermediate stop. The remaining items may be accomplished at the discretion of the pilot. All items under BEFORE TAKEOFF and subsequent checks must be accomplished for all flights.
- The pilot is responsible for proper use of the checklist. Accomplishment of each item will be indicated by the proper response. If no response is given for a particular item, stop and demand a response before continuing. The nomenclature (P), (CP), and (FM) used hereafter will refer to pilot, copilot and flight mechanic. The flight mechanic will normally read the checklist, and perform such duties as are indicated, as well as those directed by the pilot. Upon completion of each checklist, the flight mechanic will advise the pilot that the checklist called for has been completed.
- Coordinated checks. Certain items in the checklists that are accomplished by the copilot or flight mechanic require coordination with the pilot. These items are indicated by a circle around the number of the item (e.g., ①).

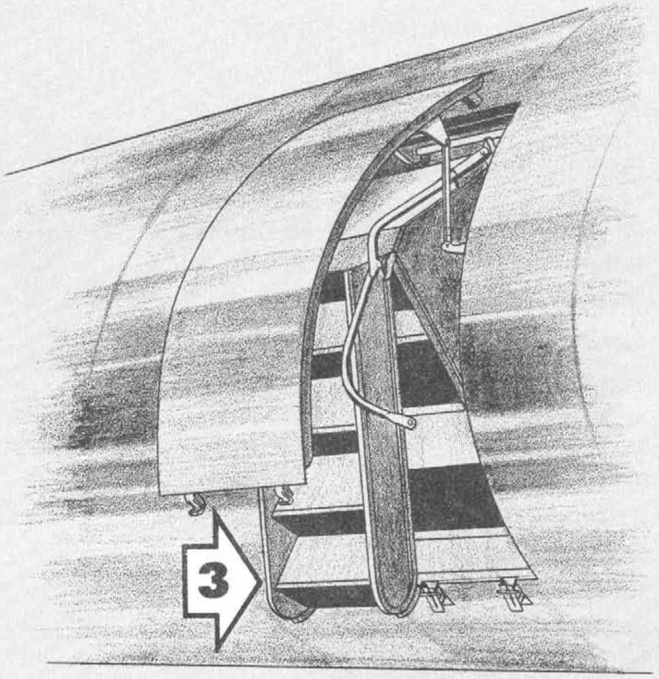
INTERIOR INSPECTION

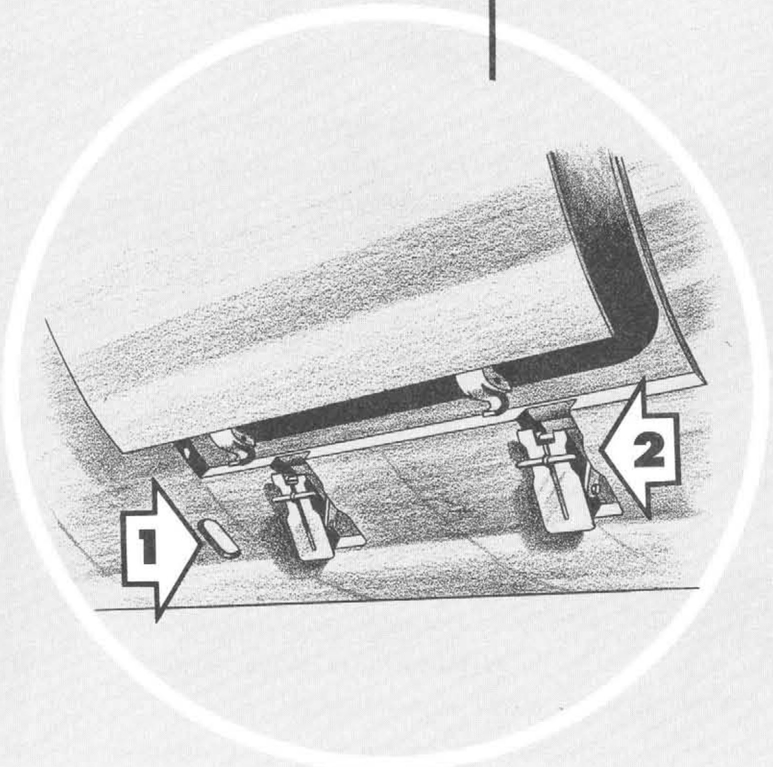
1. Form 781 — Checked.

   Check the forms for accuracy and for condition of the airplane. (Sign the exceptional release, if needed.)

OPENING ENTRANCE DOOR

FROM OUTSIDE





1 Pull exterior secondary lock handle to release the secondary lock pins . . .

2 Pull out and down on exterior primary lock handles to release door . . .

3 Lift door and grasp bottom step; then pull stair out and down . . . .

NOTE: Be sure the door-operating handle is moved to OPEN position . . . . . .

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Figure 2-1

2. Flight information publications – Checked.
3. Ignition switches – OFF.
4. Compass correction cards – Checked.
5. DC bus selector switch – NORM.
6. Battery voltage – Checked.

   Place the battery switch in the BAT position and check the dc voltmeter for a minimum reading of 18 volts. If external power is available (desired for night inspection), turn battery switch OFF and connect external power.
7. Inverter selector switch – MAIN.
8. Landing gear lever – DOWN and latched.
9. Lights – Checked as required.
   a. Landing lights
   b. Taxi lights
   c. Anticollision lights
   d. Position lights
   e. Passing lights
   f. Wheel well lights
   g. Icing (wing) inspection lights
   h. Flight compartment lights
   i. Interior lights
   j. Flashlights

Note

Lights not required for ground operation, should be turned off after this check.

10. Trim tab indicators – Set at 0°.

    Set the trim tab indicators to "zero" units of trim so that trim tab positions may be checked during the exterior inspection.
11. Wing flaps – 20°.
12. Oxygen, fuel, oil, and water quantity gages – Checked.

    The cockpit portable oxygen bottle should read 425 (±25) psi. Check that fuel, oil, and water quantity gages indicate that required amounts are on board. Depress the test button for engine oil, reserve oil, and fuel quantity gages; pointer should rotate toward empty.
13. Nacelle flap switches – Hold to OPEN.

    Holding the left and right nacelle flap switches in the OPEN position until the nacelle flaps are fully open will permit easy inspection of the augmentor vanes during the exterior inspection. The nacelle flaps should be left open during all ground operations.
14. Oil cooler switches – Hold to OPEN.
15. Fuel caps – Flush.
16. Inverter selector switch – OFF.
17. Battery switch – OFF.

CAUTION

The battery switch must be in the OFF position whenever an external dc power source is connected to the airplane. This is to prevent damage to the battery from possible abnormal voltages of the external power source.

18. External power – As required.

    If external power is to be connected, ensure that the left and right propellers are clear; then request that external dc power be connected.
19. Public address selector switch – STANDBY.
20. Cockpit fire extinguisher aft of copilot's seat – Check pressure.

    Ensure that bottle is aboard, secured, and seal is unbroken. Pressure gage should read 150 psi minimum.
21. First-aid kit and fire axe – In place.

    First aid kit seal should be intact and date on AF Form 50 must be within 180 days.
22. Radio circuit breakers – As required.
23. Cabin lights – As required.
24. Hot cups – Disconnected.
25. All galley switches – OFF.
26. Fire extinguisher at nurses' station – Check pressure.

    Pressure gage should read 150 psi minimum.
27. Hydraulic fluid level – Checked.

    Hydraulic fluid supply should be up to the FULL mark for GROUND LEVEL-GEAR DOWN.
    a. Spare fluid and wrench – Check.

       Ensure that four gallons of spare fluid is on board and a wrench available to open the filler cap.
28. Engine accessory compartment air outlet door – Open.
29. Emergency wing flap handle access door – Secure.
30. Emergency escape hatches – Secure.
31. Litter door actuating handle – NEUTRAL.
32. Litter door stop pins – In place.
33. Litter door jettison handle – Stowed.
34. Escape chute – In place.
35. Rear compartment fire extinguisher – Check pressure.

    Ensure that the bottle is secured and pressure gage should read 150 psi minimum.
36. Miscellaneous equipment – Checked and secure.

EXTERIOR INSPECTION DIAGRAM

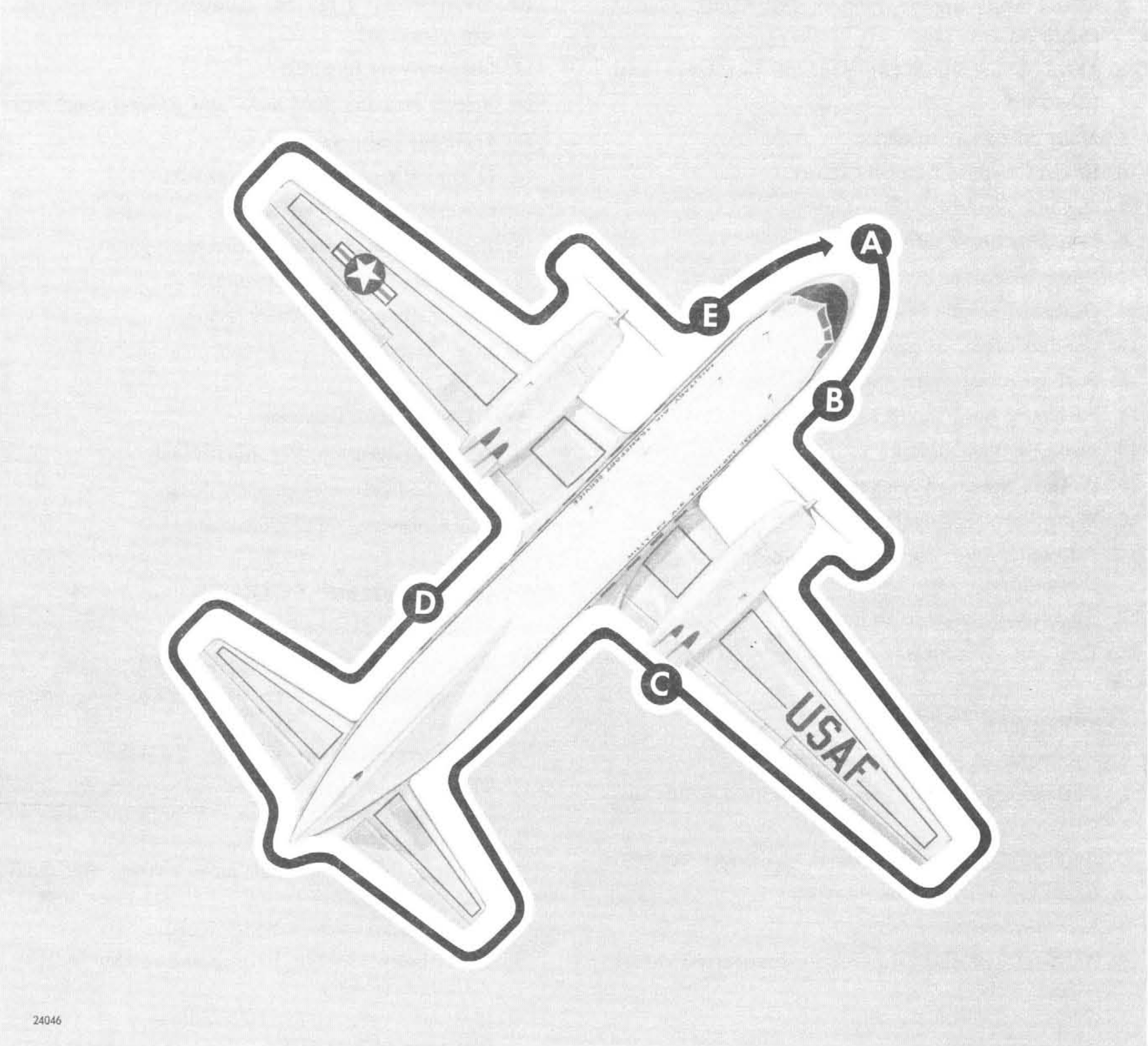


Figure 2-2

EXTERIOR INSPECTION

Perform the following checks in accordance with figure 2-2. Sign exceptional release if not signed prior to inspection.

Note

> While checking the items listed below, check that doors and inspection plates are closed; check for fluid leaks, indications of defective or insecure installations, and the general overall appearance of the airplane.

A. Nose Section

1. Scissors pin secure.
2. Nose wheel tires for general condition and pressure.
3. Steering cable for tension.
4. Nose wheel well door linkage secure and safety pins installed.
5. Pitot mast covers removed.
6. Cabin pressure relief port open.

B. Right Wing Area

1. Static ports open.
2. Right belly compartment inspected, door secure.
3. Wheel well area for fluid leaks and general condition.
4. Main wheel tires for general condition and pressure.
5. Main oil sump safetied.
6. Inboard nacelle fasteners secure.
7. General condition of engine.
8. Propeller dome safety in place.
9. Propeller for leaks and general condition.
10. Outboard nacelle fasteners secure.
11. Conduit drain for gas seepage.
12. Fuel tank inspection plates for leaks.
13. Fuel tank sump drain safetied.
14. Fuel tank vents open.
15. Position light and reflector in place.
16. Wing heat vent open.
17. Aileron checked for general condition (static dischargers).
18. Augmentor vanes in trail.
19. Flap and wing trailing edge for general condition.

C. Fuselage and Tail Area

1. Cabin pressure relief ports open.
2. Rudder and elevator general condition (static dischargers).
3. Rudder trim tab streamlined and flight tab left.
4. Right elevator trim tab down.
5. Left elevator flight tab up.
6. All fuselage and empennage inspection doors secure.

D. Left Wing Area

1. Fire bottle pressure 400 psi minimum (corrected for temperature). Electric wires secure and pressure switches checked.
2. Augmentor vanes in trail.
3. Flap and wing trailing edge for general condition.
4. Aileron checked for general condition (static dischargers).
5. Wing heat vent open.
6. Position light and reflectors in place.
7. Fuel tank vents open.
8. Fuel tank sump drain safetied.
9. Fuel tank inspection plates for leaks.
10. Conduit drain for gas seepage.
11. Landing gear safety microswitch secure.
12. Main wheel tires for general condition and pressure.
13. Ground wire in place.
14. Wheel area for fluid leaks and general condition.
15. Main oil sump safetied.
16. Outboard nacelle fasteners secure.
17. General condition of engine.
18. Propeller dome safety in place.
19. Propeller for leaks and condition.
20. Inboard nacelle fasteners secure.
21. Static ports open.

E. Left Belly Compartment

1. General condition of compartment.
2. Close and secure inspection door.
3. Cabin pressure relief port open.

BEFORE STARTING ENGINES

*1. Form 781 — Completed. (P)

*2. Passenger briefing—Completed. (P)

Refer to Section VIII for passenger briefing checklist.

*3. Litter loading door—Checked. (FM)

The flight mechanic will visually check the litter loading door for proper latching, stop pins in place, and jettisoning lever safetied.

*4. Landing gear pins and pitot covers—Removed and stowed. (FM)

5. Oxygen masks — Installed. (ALL)

*6. Safety belts, shoulder harness and rudder pedals — Adjusted. (P-CP)

7. Hydraulic pressure bypass handle — PRESS (DWN). (FM)

*8. Load monitor switch — NORMAL. (CP)

*9. Bus voltage — Checked. (CP)

Place the dc voltmeter selector switch on BUS. Voltage should read 28 volts on external power, 24 volts with fully charged battery.

*10. Inverters — Checked. (CP)

Place the inverter selector switch in the SPARE position. Place the ac voltmeter selector switch in the SPARE INV position and check voltage; read 115 (±2.5) volts. Place the voltmeter selector switch in the 26V position; read 26 to 29 volts. Then place the inverter selector switch to the MAIN position.

Note

- When the inverter selector switch is placed in the SPARE position, the main inverter should drop off the line.
- Voltage may deviate slightly from normal until the inverter has reached a normal operating temperature. These deviations are slight and should stabilize within 10 to 15 minutes.
- If external power is not available, keep the inverter switch in OFF position until one engine is operating.

*11. Battery switch — As required. (CP)

If external power is not available, place the battery switch in the BAT position for starting. This is considered an emergency procedure. Skip all electrical checks until after the engines are started.

12. Emergency hydraulic pump — Checked. (CP)

Place the emergency hydraulic pump switch in the ON position. Observe an increase in pressure to 2900 psi (relief valve cutout), then return the switch to OFF and close the switch guard.

13. Alternator selector switch — NORMAL. (CP)

14. Alternator switches — OFF. (CP)

Check that the No. 1 and No. 2 alternator switches are in the OFF position and that the alternator failure lights are out.

15. Blower switches — LOW. (CP)

16. Water injection switch — OFF. (CP)

17. Propeller speed control levers — INCREASE RPM (highlights). (CP)

18. Autofeather switch — OFF. (CP)

19. Reverse propeller override handles — OUT. (CP)

Check that the manual override handles are fully out and that the reverse propeller override indicator lights are illuminated. If the handles are in or the lights are out, have the trouble corrected before proceeding further.

*20. Throttles — Cracked. (P)

Prior to engine start, the throttle should be positioned to give 800-1000 rpm.

Note

A throttle position corresponding to 1000 rpm will produce the most satisfactory engine start. Observation of the engine throttle position at 1000 rpm during engine shutdown will determine the throttle position for starting.

21. Autopilot engaging levers — OFF. (CP)

*22. Carburetor heat-control levers — COLD. (CP)

Note

If the control levers are in the HOT position while starting and the engine backfires, there is a possibility of damage to the air induction system. If the backfiring occurs, STOP and check for any damage before continuing.

*23. Mixture control levers — IDLE CUTOFF. (CP)

24. Emergency landing gear uplatch release knob — Safetied OFF. (P)

25. "Fasten Seat Belt" and "No Smoking" signs — ON. (P)

26. Emergency air brake knob — Safetied OFF. (P)

*27. Parking brakes — Reset. (P)

28. Static source selector valves — STATIC PRESSURE. (P-CP)

29. Fire extinguisher selector switch (some airplanes) — MAIN. (CP)

30. Engine fluid-off handles — IN. (CP)

*31. Fire detection circuits — Checked. (CP)

Hold the toggle switch in the DET "A" L & R NAC & FUS OIL position until all three indicator lights illuminate. Hold the switch in the DET "B" L & R NAC position until the two engine indicators illuminate.

CAUTION

If the fire warning lights do not illuminate within 15 seconds after actuating the test switch of either system, the fire detection system is defective.

WARNING

Fire detection system defects must be corrected before the airplane is released for flight. A defective fire detection system could endanger the airplane and personnel aboard in event of fire.

Note

The fire detection system circuits must be tested both before and after the engines are started.

*32. Main hydraulic, brake, and air brake pressure gages — In limits. (CP)

*33. Copilot's console switches — Set for starting. (CP)

  a. Pitot heat switch — OFF.
  b. Anticollision light switch — OFF.
  c. Wheel well and nose compartment lights switch — OFF.
  d. Passing light switch — Climatic.

e. Navigation position lights switch – Climatic.
f. Cabin heat and vent switch – SHUTOFF.
g. Wing inspection lights – OFF.
h. Heat anti-ice button – PULL OFF.
i. Structural overheat limit override switch – NORMAL.
j. Alternator-generator hydraulic system switch – ON.

CAUTION

In order to avoid momentary high pressures in the alternator-generator hydraulic system, the system should be on before starting the right engine and left on throughout subsequent ground and flight operations.

k. Direct vision anti-ice switch – OFF.
l. Cabin pressurization switch – AUTO.
m. Cabin pressurization dump valve – Safetied NORMAL.
n. Windshield anti-ice switch – OFF.
o. Reserve oil heat switch – OFF.
p. Augmentor vane arm switch – OFF.
q. Cabin heat selector switch – AUTO.
r. Cabin heat rheostat – As desired.
s. Propeller de-ice switch – OFF.
t. Propeller de-ice circuit breakers – In.
u. Cockpit heater switch – OFF.
v. Cabin pressurization controls – Set.
w. Spare lamp supply – Checked.

*34. Circuit breakers and warning lights – Checked. (ALL)

Recheck all circuit breakers to ensure that none have tripped.

35. Manual heat anti-ice shutoff handles – Safetied ON. (FM)

36. Fuel crossfeed handle – OFF. (P)

37. Main fuel shutoff valve switches – ON. (P)

Check that the indicator lights are out.

38. Landing and taxi light switches – RETRACTED & OFF. (P)

39. Fuel booster pump switches – OFF. (CP)

*40. Ignition switches – OFF. (CP)

*41. Oil cooler control switches – AUTO. (CP)

*42. Radio UHF and VHF – ON. (CP)

If using battery power for starting, radios should remain off to conserve battery power.

*43. Field barometric pressure – Checked. (P)

*44. Before starting engines check – Completed. (FM)

STARTING ENGINES

*1. Fire guard and wheel chocks – In place. (P-CP)

Ensure that ground fire fighting equipment is available and that a fire guard is posted.

*2. Left engine – Clear. (P)

Determine that all loose material, ground equipment, and personnel are at a safe distance from the airplane.

*3. Start left engine. (P)

Note

The left engine is started first because the main entrance door and the external power connections are located on the right side of the fuselage.

a. Fuel booster pump switch for left engine – ON (check pressure).
b. Engine starter selector switch – LH.

Note

If a battery start must be made, reduce the electrical load to the minimum and turn off the inverter. After an engine has been started, turn the inverter switch to MAIN.

c. Start switch – ON.

CAUTION

- The start switch must not be held to ON for more than one minute. If a start is not obtained, wait one minute, then attempt another start. If the second start is not successful, wait five minutes to allow the starter to cool before attempting further starting.
- To conserve battery power when starting with the airplane's batteries, do not exceed 30 seconds of continuous cranking.
- Discontinue the starting procedure if any indication of hydraulic lock is noted while turning the propeller through continuously.

d. Ignition switch for left engine – BOTH, after 8 blades.

Note

A count of 15 blades will insure adequate engine pre-oiling when making a cold start. If the engine is started within one hour after shutdown, a count of eight blades is sufficient to detect hydraulic lock.

Hold the ignition boost switch to the ON position immediately after placing the ignition switch to BOTH.

e. Prime switch (toggle intermittently) – ON as required.

Hold the prime switch in the ON position intermittently if the engine is warm (on one second and off two seconds). If the engine is cold, hold the switch ON continuously. Holding the prime switch in the ON position after the engine fires has been found to give the most satisfactory start.

CAUTION

Overpriming must be guarded against to prevent scuffed cylinders due to the inevitable dilution of the oil film on the cylinder walls by fuel that condenses on them during the priming. Overpriming may also lead to excessive torching immediately after engine start.

f. Throttle – 800-1000 rpm.

The initial rpm surge which occurs during the engine start should not be allowed to exceed 1000 rpm. When the engine is running smoothly at 800-1000 rpm on prime alone, release the start switch and the ignition boost switch to the OFF positions.

g. Oil pressure – Checked.

Check for a positive rise in oil pressure immediately after the engine starts.

CAUTION

If the oil pressure does not rise to at least 40 psi in 10 seconds, stop the engine and investigate.

h. Mixture control – AUTO RICH.

Note

With the engine running smoothly at 800-1000 rpm on prime alone, ease the mixture control lever slowly out of IDLE CUT OFF into AUTO RICH. Release the prime switch to the OFF position when the rpm starts to drop.

CAUTION

- If the engine stops, immediately return the mixture control lever to IDLE CUTOFF and continue cranking and priming for a second start.
- Do not move the throttle rapidly during start as this can result in a ruptured carburetor balance diaphragm.

i. Throttle – 1000 rpm.

After the engine is running smoothly on AUTO RICH, adjust the throttle to maintain approximately 1000 rpm.

Note

If oil temperature was below 40°C (104°F) before engine start, engine oil pressure may start abnormally high. Reduce engine speed, if necessary, to prevent excessive pressures until oil warms up. Pressure should stabilize within the allowable range during engine warmup.

j. Mixture control – AUTO LEAN.

To prevent spark plug fouling, place mixture control lever in AUTO LEAN for all ground operation below 1500 rpm.

k. Fuel booster pump switches – OFF. (P)

Check that engine fuel pressures remain within normal limits after the fuel booster pump switches have been turned to OFF.

l. Engine starting selector switch – OFF. (P)

*4. External power – Disconnected. (P)

Visually check that the external power source has been disconnected and that the power unit has been removed.

*5. Battery switch – ON. (CP)

*6. Main entrance door – Closed. (FM)

WARNING

- Due to the hazard of the rotating propeller, all passengers will be aboard and the main entrance door closed prior to starting the right engine.
- The main entrance door will not be opened with the right engine operating.

*7. Left hydraulic pump – Checked. (CP)

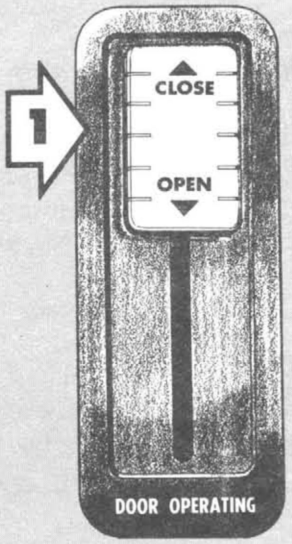
As the main entrance door closes, a drop in pressure without a corresponding rise will indicate that the left hydraulic pump is inoperative.

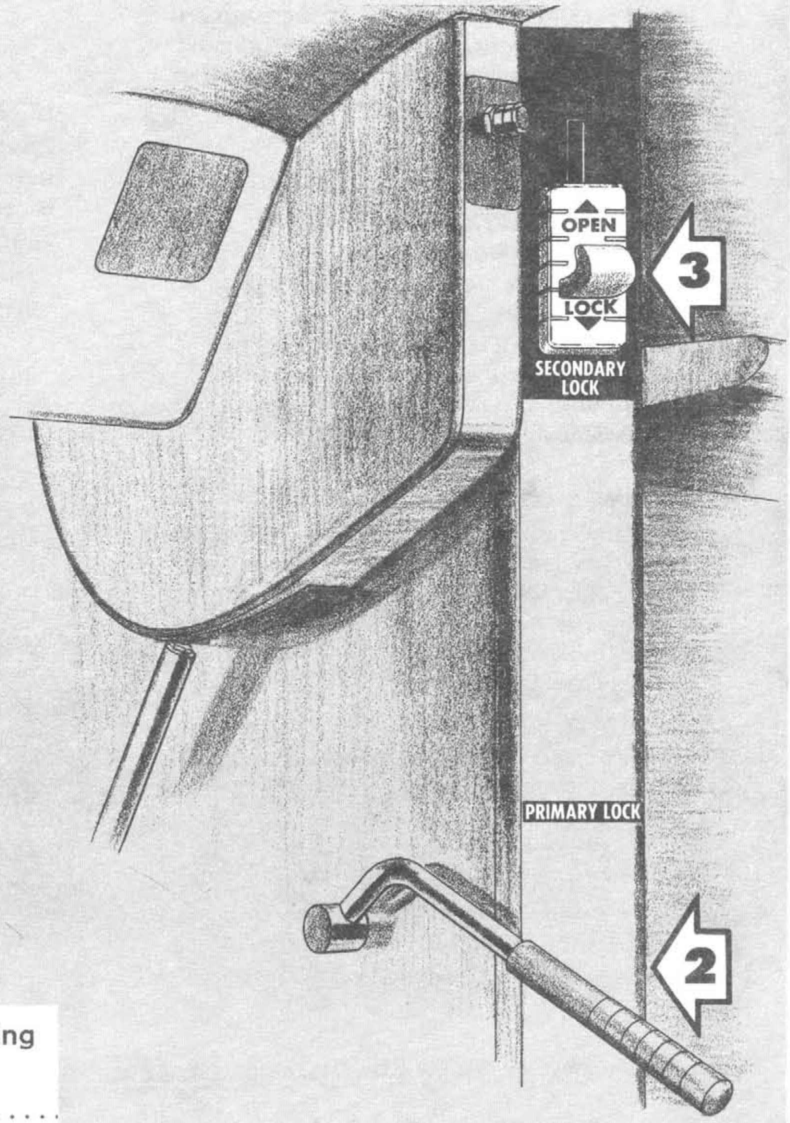
*8. Door-open warning light – Out. (CP)

The door-open warning light should be out. Depress the light to ensure that the bulb will illuminate. Test the door solenoid lock by actuating the entrance door unlatch switch. While

CLOSING ENTRANCE DOOR

FROM INSIDE





1 Move the door-operating handle to the CLOSE position . . . .

2 Move primary lock lever down to LOCK position after door is closed . . . . . .

3 Move secondary lock handle to the LOCK position . . . .

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Figure 2-3

holding this switch in the ON position, check that the green indicator light above the door secondary lock handle is illuminated. This indicates pilot control of the door unlocking mechanism.

*9. Load monitor switch – OVERRIDE. (FM)

*10. Engine analyzer – ON. (FM)

*11. Repeat starting procedure for right engine. (P)

*12. Starting engines check – Completed. (FM)

ENGINE GROUND OPERATION

Note

- Warm up the engines at 1000 rpm to keep generators in operation. Do not exceed 1000 rpm until oil temperature and pressure reach normal range.
- To prevent and combat lead or other fouling accumulations on the spark plugs and in the combustion chamber, maintain approximately 1000 rpm and make periodic runup of the

engine during prolonged periods of ground idling. This runup will consist of operating the engine with the propeller in full increase rpm (highlights), mixture AUTO RICH, at a manifold pressure equal to the field barometric pressure for a period of one minute at ten-minute intervals.

- Do not exceed field barometric pressure during normal ground operation except for momentary accessory checks.
- Limit duration of power runs to ten seconds. Do not exceed 40 inches Hg manifold pressure. Refer to OPERATING LIMITATIONS, Section V.

BEFORE TAXIING

*1. Cabin heat and vent switch – NORMAL. (CP)

*2. Anticollision light – ON. (CP)

*3. Radios – ON. (CP)

*4. IFF/SIF – STANDBY. (CP)

*5. AC voltage – Checked. (FM)

   a. With the inverter selector switch in the MAIN position, check the main inverter voltage output by placing the ac voltmeter selector switch in MAIN INV; read 115 (±2.5) volts.

   b. Check the voltage of the transformer by placing the ac voltmeter selector switch in the 26V position. Check for indication.

   c. Check the spare inverter voltage by placing the ac voltmeter selector switch in SPARE INV; read 115 (±2.5) volts.

   d. Return the voltmeter selector switch to MAIN INV for normal operation.

*6. Cabin compressor and alternator-generator hydraulic pressures and temperatures – In limits. (CP)

*7. Flight instruments – Checked and set. (P-CP)

   a. Airspeed indicators – Checked.

   b. Directional indicators – Checked and set. Check slaved gyro and RMI for slaving and proper heading. Set directional indicator; slowly uncage.

   c. Attitude indicators – Checked. Align MM-1 horizon bar with the miniature airplane. Cage the J-8 and align the miniature airplane with the 90° indices.

WARNING

To avoid the possibility of a takeoff with J-8 attitude indicator erected in the inverted position, cage it prior to takeoff to ensure proper erection.

Note

The J-8 attitude indicator should be energized for at least 30 seconds prior to caging.

   d. Vertical velocity indicators – Checked.

   e. Magnetic compass (standby) – Checked. Check fluid level and that compass indicates the approximate airplane heading.

   f. Altimeter and clock – Set.

WARNING

It is possible to misset the altimeter by 10,000 feet and still have the correct indication on the barometric scale. This happens when the barometric set knob is continuously rotated after the barometric scale is out of view until eventually the numbers reappear in the Kollsman window from the opposite side. If the correct altimeter setting is then established the altimeter will read 10,000 feet in error. To avoid the possibility of this error, pay particular attention to the 10,000-foot pointer when setting the altimeter.

*8. Fire detection system – Checked. (CP)

Hold the toggle switch in the DET "A" L & R NAC & FUS OIL position until all three indicator lights illuminate. Hold the switch in the DET "B" L & R NAC position until the two engine indicator lights illuminate; failure of the proper indicator lights to illuminate means the system is defective.

*9. Ignition switch check – Completed. (FM)

Accomplish an ignition switch check at 800 rpm with the propeller in low pitch (INCREASE RPM). Switch the ignition switch from BOTH to L, to R, to OFF momentarily, and then back to BOTH. Proper connection of ignition leads will be indicated by a slight drop of rpm when operating on each magneto and by complete cutting out of the engine in the OFF position.

WARNING

If the engine does not cease firing when the ignition switch is in the OFF position, the magneto ground wire is open. In this case, personnel must be warned to keep clear of the propeller after the engine is shut down until the defect has been corrected.

CAUTION

Perform this check as rapidly as possible to prevent severe backfiring when the switch is turned on again.

Note

The ignition switch check may be accomplished using the engine analyzer by observing L-1 and L-2 circuits for grounding when the ignition switch is in the R position, and R-1 and R-2 circuits for grounding when ignition switch is in the L position.

*10. Wheel chocks—Removed. (P)

Signal the ground crew when ready to taxi. When chocks have been removed, release the brakes on the ground crew's signal.

*11. Before taxi check—Completed. (FM)

Call the tower for taxi clearance.

TAXIING

POWER REQUIREMENTS

Immediately before taxiing, reduce throttles to idle speed, and ensure that the area is clear before moving the airplane. Taxi with the engines at 800 to 1000 rpm to keep generators in operation. Normally, keep mixture control levers in AUTO LEAN.

Note

If operating off a field having a higher elevation than the home base, it will be necessary to lean the mixture by pulling the mixture control levers back toward the IDLE CUTOFF position. Rough idling and difficulty in keeping the engines running will be encountered because of the richer mixtures at higher elevations.

STEERING

Directional control during taxiing is normally accomplished by means of the steerable nose wheel. Minimum turning diameter required, in order to keep all wheels on a runway and using only the nose wheel steering control, is approximately 60 feet. Minimum wing tip turning diameter for clearance is approximately 125 feet. Avoid overuse of brakes, high-speed turns, and sudden stops. Check operation of brakes and gyro instruments while taxiing. Stop the airplane prior to takeoff with the nose wheel straight ahead. For added ground safety at night, use all available lights when taxiing.

TAXIING

*1. Brakes—Checked. (P)

Check brakes immediately when starting to taxi from the parking area. Make periodic checks of brake effectiveness during taxiing. Check main hydraulic pressure and brake hydraulic pressure at regular intervals while taxiing.

*②Wing flaps—UP. (FM)

*3. Turn-and-slip and directional indicators—Checked. (P-CP)

Check turn-and-slip and directional indicators for proper turn indications while taxiing.

4. Carburetor heat—Checked. (FM)

Position the carburetor heat control levers in the fully HOT position until a rise in carburetor air temperature is noted, then return the levers to COLD. Allow at least two minutes for CAT to stabilize before attempting a takeoff.

5. Augmentor vanes—Checked and trail. (CP-FM)

Place the augmentor vane arm switch in the ARM position. Check operation of vanes by holding the left and right vane switches in the CLOSE position and observing the corresponding indication of augmentor vane position indicators. Hold the switches in the TRAIL position until vanes start to trail. Then release the switches and place the vane arm switch to OFF. Vanes will start to trail. Push the heat anti-icing button in and vanes will stop. Pull the heat anti-icing button out and note indicators. Vanes will trail.

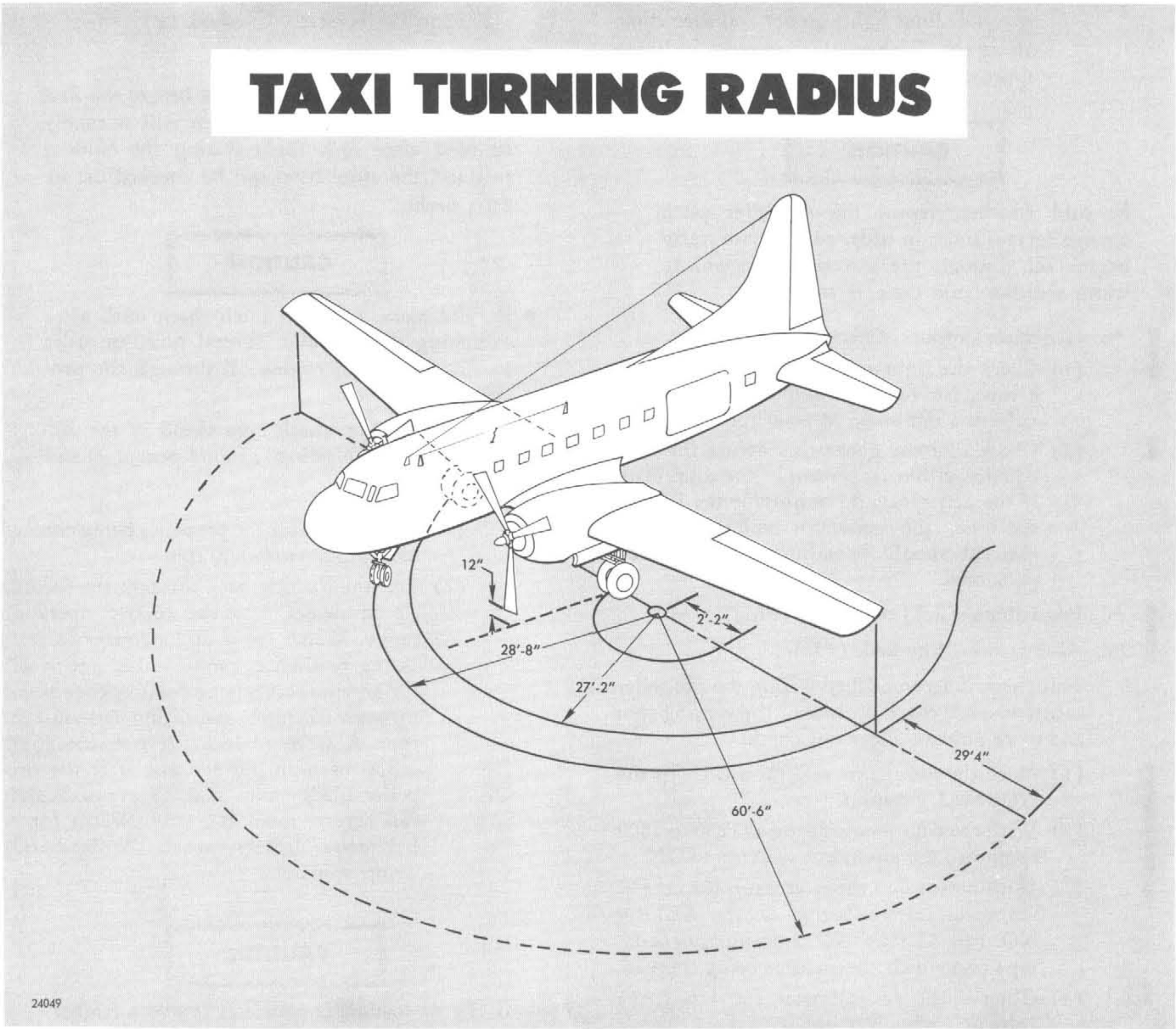
6. Crossfeed—Checked and OFF. (FM)

   a. Fuel crossfeed handle—OPEN.
   b. Right fuel valve switch OFF, left booster pump switch ON. Note increase in right fuel pressure. Right fuel valve switch ON. Left booster pump switch OFF.
   c. Left fuel valve switch OFF. Right booster pump switch ON. Note increase in left fuel pressure. Left fuel valve switch ON. Right booster pump switch OFF.
   d. Fuel crossfeed handle—OFF.

*7. Taxi check—Completed. (FM)

CAUTION

- Avoid sharp turns when taxiing at high speeds in order to prevent damage to the nose gear and to prevent excessive wear on the tires.
- Reverse taxiing is an emergency procedure. If reverse taxiing is necessary, avoid high power operation, sharp brake applications, and rough or rutted runways in order to prevent pitching the airplane on its tail.
- Do not taxi in reverse for long periods; to do so will cause excessive heat inside the nacelles. Keep nacelle flaps closed to insure adequate engine cooling.



TAXI TURNING RADIUS

Figure 2-4

ENGINE RUNUP

*1. Parking brakes – Set. (P)

Note

With the airplane headed into the wind, and with parking brakes set, place throttles for warmup at 1000 rpm until oil pressure and temperature reaches normal range. On cold starts, it may be necessary to hold warmup to a lower setting if backfiring occurs.

*2. Oil temperatures – 40°C Minimum. (P)

*3. Mixture control levers – AUTO RICH. (CP)

*4. Engines – Checked. (P)

  a. Manifold pressure gage line – Drain. (P)

  *b. Propeller governors – Checked. (P)

  Exercise the propeller speed control levers, checking that engine rpm changes according to propeller pitch change as follows:

  (1) Throttles (both engines) – 1500 rpm.

  (2) Propeller speed control levers – INCREASE RPM (high lights).

  (3) Propeller speed control levers – DECREASE RPM (low lights).

  Hold the propeller speed control levers in the DECREASE RPM position until governor limit lights go out and come on again. Tachometers should indicate approximately 1200 rpm.

  (4) Propeller speed control levers – INCREASE RPM (high lights).

  Hold the propeller speed control levers in the INCREASE RPM position until the governor limit lights go out and then come on again. Tachometers should indicate approximately 1500 rpm.

CAUTION

In cold weather, repeat the propeller pitch change several times in order to circulate warm engine oil through the governing system. In warm weather, one cycle is sufficient.

*c. Generator output – Checked. (FM)

(1) Check the right and left generators, one at a time, for required output of 28 to 28.5 volts at a minimum of 1000 rpm.

(2) Check that the generators divide the load equally within 10 percent of the total load. If the generators do not divide the load as specified, the generator voltage control rheostat should be adjusted by qualified personnel.

*d. Bus voltage (dc) – Checked. (FM)

*e. Alternators – Checked. (FM)

This check is accomplished during the propeller constant speed check because of the varying rpm and more positive alternator check.

(1) Place the alternator selector switch in the NORMAL position.

(2) With the engines operating at 1200 to 1500 rpm, turn the alternator switches to ON.

(3) With no load on the alternator, turn the ac voltmeter selector switch to the ALTRN NO. 1 or ALTRN NO. 2 position, depending upon which alternator is being checked.

(4) Observe the ac voltmeter for 115 (±5) volts on each alternator bus.

f. Propeller blade switch – Checked. (P) (Perform one at a time.) With engine operating at 1500 rpm and propellers in the full increase rpm condition, pull the feathering button out firmly and hold until rpm stabilizes at approximately 1200 rpm. Immediately release the feathering button to the neutral position when rpm stabilizes. Check that the rpm returns to 1500 and that the generator loadmeter indicates a return to the normal load. If the rpm does not stabilize and continues to decrease while holding the feathering button out, a propeller malfunction is indicated.

CAUTION

To avoid overloading the engine sump, do not repeat this check more than three times on one engine until the engine has operated for at least two minutes following a test.

g. Propeller reverse – Checked. (P)

Note

Make a propeller reverse check before the first flight of the day. Reverse pitch will normally be used after each flight during the landing roll and therefore need not be checked before each flight.

CAUTION

- Do not make a reverse pitch check until after exercising the propeller several times in order to circulate warm engine oil through the propeller system.
- Before reversing, check area ahead of the airplane to avoid "blasting" ground personnel and equipment.

(1) Reduce rpm for the propeller being checked to approximately 800 rpm.

(2) Pull the throttle back through the throttle closed detent into the reverse operating range. Watch for a dc loadmeter increase as the feathering pump starts, and watch for an rpm increase as the propeller passes through flat pitch, stabilizing at 1200-1500 rpm. A solenoid lock prevents the application of high power until after the propeller blades have reached approximately full reverse pitch of −25°. Watch for dc loadmeter decrease when the feathering pump stops.

CAUTION

If the dc loadmeter indicates that the feathering pump has not stopped, cut dc power and pull the propeller feather circuit breaker to prevent damage to feather pump motor.

Note

Normal power range is considered to be from 1200 to 2000 rpm. Throttle pressure of approximately 28 pounds is required to force the throttle through the aft detent position if additional thrust is required.

CAUTION

Limit the use of high power settings, with propeller in reverse pitch, to short intervals to avoid overheating vital engine accessories. Critical temperatures are not detected by the normal engine instruments.

(3) Return the throttle to normal operating range. Watch for an increase, a decrease,

then an increase of approximately 200 to 300 rpm when returning the throttle to the normal operating range. This surge will occur as the blades pass through flat pitch, and will serve to indicate that the propeller has returned to forward thrust operation.

(4) After the reverse check has been completed rpm will be set at 1500, and propeller control moved to high pitch (DECREASE RPM). Check tachometers for decrease in rpm. This indicates that the engines are out of reverse. Return the throttle and rpm to normal operating position.

*h. Engine power — Checked. (P)

(1) Idle one engine at approximately 1000 rpm while testing the other.

(2) Manifold pressure — Equal to field barometric pressure.

(3) RPM for engine being tested — Left engine 2100 (±50), right engine 2050 (±50).

Note

- When making a power check in a headwind, approximately two rpm should be added to the above check rpm for each mile per hour headwind.
- If the approximate engine speed cannot be obtained, the engine is not operating properly.

(4) Engine instruments — Checked.

i. Blowers — Checked and LOW. (P)

(1) Move the blower switch to HIGH. Observe fluctuation of oil pressure and a two-inch rise in manifold pressure.

(2) Move the blower switch to LOW. Observe fluctuation of oil pressure and a decrease in manifold pressure.

Note

Refer to Section VII for additional information on engine blower shift operation.

*j. Ignition system — Checked. (FM)

(1) Engine analyzer — Check ignition.

(2) Shift the ignition switch from BOTH to R.

(3) Allow rpm to stabilize, noting portion of rpm drop that is fast and portion that is slow.

(4) Shift the ignition switch back to BOTH and allow rpm to stabilize.

(5) Shift the ignition switch from BOTH to L.

(6) Allow rpm to stabilize, noting portion of rpm drop that is fast and portion that is slow.

(7) Shift the ignition switch back to BOTH.

Note

The normal drop-off when operating on one magneto should be 25 rpm. Maximum permissible drop-off is 65 rpm. Difference between left and right should not exceed 40 rpm. Operation on single magneto must not exceed 60 seconds at any one time.

k. Water injection system — Checked. (P)

(1) Water injection switch ON.
Check that the water pressure-on indicator lights illuminate as water pressure comes up to 18 psi or higher.

(2) Water pressure — Within limits.

(3) Advance the throttle to obtain a drop in water pressure (35-40 inches Hg manifold pressure). Then, without retarding the throttles, turn the water injection switch OFF and check for an increase in fuel flow to indicate the return to dry power fuel-air ratio.

*l. Propeller autofeathering system — Checked. (P)
Perform the following check before each flight.

(1) Autofeather switch — ON (green light on).

(2) Retard throttle slowly until feather button red light comes on (1500-1700 rpm, torque pressure 35-45 psi — 40 psi desired).

(3) Autofeather test switch — Hold to LH.
After approximately two seconds, the left manual feathering button will pull in. After a 200 rpm drop, release the test switch to OFF and pull out the left manual feathering button to the neutral position. Feather action will stop and rpm will return to the original setting. The green light will be out.

(4) Autofeather switch — OFF.

CAUTION

- Leaving the autofeather switch ON after the second test would leave the system disarmed and inoperative. The switch must be turned to OFF after each test. It is turned ON again just prior to takeoff.
- To avoid overloading the engine sump, do not repeat the feathering and unfeathering test until the engine has operated for at least two minutes following a test.

Note

The test of the autofeathering system is not complete until it is observed that the red lights in the two manual feathering buttons go out as the throttles are advanced beyond approximately 25 inches Hg manifold pressure (45 psi torque pressure). As the throttles are retarded the lights will come on again at approximately 20 inches Hg manifold pressure. If either or both of the lights fail to go out as the throttles are advanced, an autofeather torque pressure switch malfunction is indicated. Takeoff must be postponed until the defect has been corrected.

m. Propeller manual feathering check – Climatic. (P-FM)

Note

Make a manual propeller feathering check in cold weather. If the rpm drop is very slow or sluggish, repeat the check until satisfactory operation is obtained. Otherwise, overspeeding may occur on takeoff.

(1) With the engine operating at approximately 1500 rpm, depress the manual feathering button.
(2) The red light in the button will illuminate, indicating that the feather pump is in operation and that the propeller is feathering.
(3) As engine rpm drops approximately 200 rpm, pull out the feathering button to its neutral position. The propeller will return to the control of the governor.

(*5.) Radios – Checked. (CP)

a. TACAN and VOR.
   (1) RMI bearing indicator. Check for approximate station bearing.
   (2) Course deviation indicator. Set bearing shown under RMI bearing indicator in course window, and CDI should center. CDI warning "OFF" flag should be hidden.

b. TACAN range indicator.
   With control box in T/R position, the warning "OFF" bar should disappear and approximate distance to the station should be shown.

c. ILS.
   Check for displacement of the CDI and glideslope indicator.

d. Radio compass.
   Check bearing indicator for approximate station bearing. Check set on ANT, ADF, and LOOP positions.

*6. Engine runup check – Completed. (FM)

BEFORE TAKEOFF

① Anti-icing and de-icing equipment – As required. (P-CP)

a. Cockpit heat – Climatic.
b. Cabin heat – Climatic.
c. Pitot heaters – Climatic.
d. Windshield wipers – Climatic.
e. Propeller de-ice – Climatic.
f. Windshield anti-ice – Climatic.
g. Wing and tail anti-ice – Climatic.

Note

Wing and tail anti-icing will take effect as soon as ram air is available. Propeller de-icing will be effective as soon as it is turned on if 115-volt ac current is being supplied to Bus No. 1.

2. Circuit breakers – Checked. (ALL)
   Check that all circuit breakers are in and that none have tripped.
3. Load monitor switch – NORMAL. (CP)

④ Wing flaps – Set for takeoff. (FM)

5. Alternator switches – ON. (CP)
6. Blower switches – LOW. (CP)

WARNING

Takeoff in high blower is prohibited.

7. Propeller speed control levers – INCREASE RPM (high lights). (CP)
   Hold the left and right propeller speed control levers in the INCREASE RPM position and observe that the indicator lights remain illuminated as indication that the propellers are in low pitch.
8. Autofeather switch – ON (green light on). (CP)
   Place the autofeather switch in the OFF, then in the ON position; check that the green autofeather light and the red manual feathering button lights are illuminated.

CAUTION

If the switch has been left in the ON position move to OFF, then to ON to rearm the autofeathering system. Failure to do this will result in the system becoming inoperative.

9. Flight controls – Checked. (P)
   Check that the gust control lock is fully forward and move all controls to check for freedom and correct movement.
10. Carburetor heat control levers – Climatic. (CP)

Note

Normally all takeoffs are made with the carburetor heat control in the COLD position; however, if atmospheric conditions are conducive to ice, carburetor heat may be used on takeoff to aid the vaporization of fuel and to improve carburetor performance.

CAUTION

With carburetor heat applied during takeoff, a pronounced CAT rise should be expected. Do not allow temperatures to exceed limits.

11. Trim tabs – Set. (P)
    The elevator trim tab is normally set for approximately 2½ to 3 units of nose-up trim. Rudder and aileron are set at zero.
12. Fuel booster pump switches – ON. (FM)
    Place the left and right fuel booster pump switches in the ON position and check that fuel pressure is within limits.
13. Refusal and takeoff speeds – Checked. (P)
14. Crew briefing – Completed. (P)
    The pilot will brief the copilot and the flight mechanic to ensure that they know their duties during takeoff.

LINEUP

When cleared to the runway for takeoff:

1. Mixture control levers – AUTO RICH. (CP)
2. Water injection switch – As required. (CP)
   If used, check that water quantity is within normal limits and that both water pressure on indicator lights are illuminated.
3. Nacelle flaps – MID POSITION. (FM)
4. Windows – Closed and locked. (P-CP)
5. IFF/SIF – Set. (CP)
6. Before takeoff check – Completed. (FM)

TAKEOFF

Note

The takeoff charts in the Appendix are based on setting maximum power before releasing the brakes; however, releasing the brakes at field barometric pressure (inches Hg MAP) and advancing the throttles smoothly to maximum power, results in nominal difference in performance.

Prior to commencing takeoff roll, the pilot will advance power and the flight mechanic will call "lights out" when the feather button lights go out. In the event a feather button light does not go out, takeoff will not be initiated. See figure 2-5 for typical takeoff procedures.

WARNING

If one or both of the red lights in the manual feathering buttons fail to go out when the throttles have been advanced beyond the position corresponding to 40 inches Hg manifold pressure, takeoff must be postponed until the trouble has been corrected. If takeoff should be attempted with one or both of the red lights on and the autofeather switch in the ON position, one propeller would feather as soon as the throttles were advanced beyond the 45 inches Hg manifold pressure position.

The pilot will advance the throttles to 40-50 inches Hg manifold pressure. At the command of "maximum power" the copilot will advance the throttles to the maximum power setting. The pilot will maintain directional control with nose wheel steering until rudder control becomes effective, at approximately 70 to 80 KIAS. During takeoff roll the flight mechanic will monitor all engine instruments. In the event of any malfunction or indication of malfunction prior to reaching refusal speed, the crew member observing the malfunction will call "Abort." The copilot monitors takeoff acceleration and will call "Go" upon reaching refusal speed. At approximately 80 knots, apply sufficient back pressure to level the fuselage. At 10 knots below takeoff speed the pilot will smoothly apply back pressure so that takeoff attitude (approximately 10° on the MM-1 attitude indicator) is assumed at the same time takeoff speed is reached. Standard visual and oral gear-up signal will be given by the pilot. The copilot will not touch the gear handle until the gear-up signal is given. The copilot will repeat the visual and oral command and raise the gear handle.

TAKEOFF WITHOUT WATER INJECTION

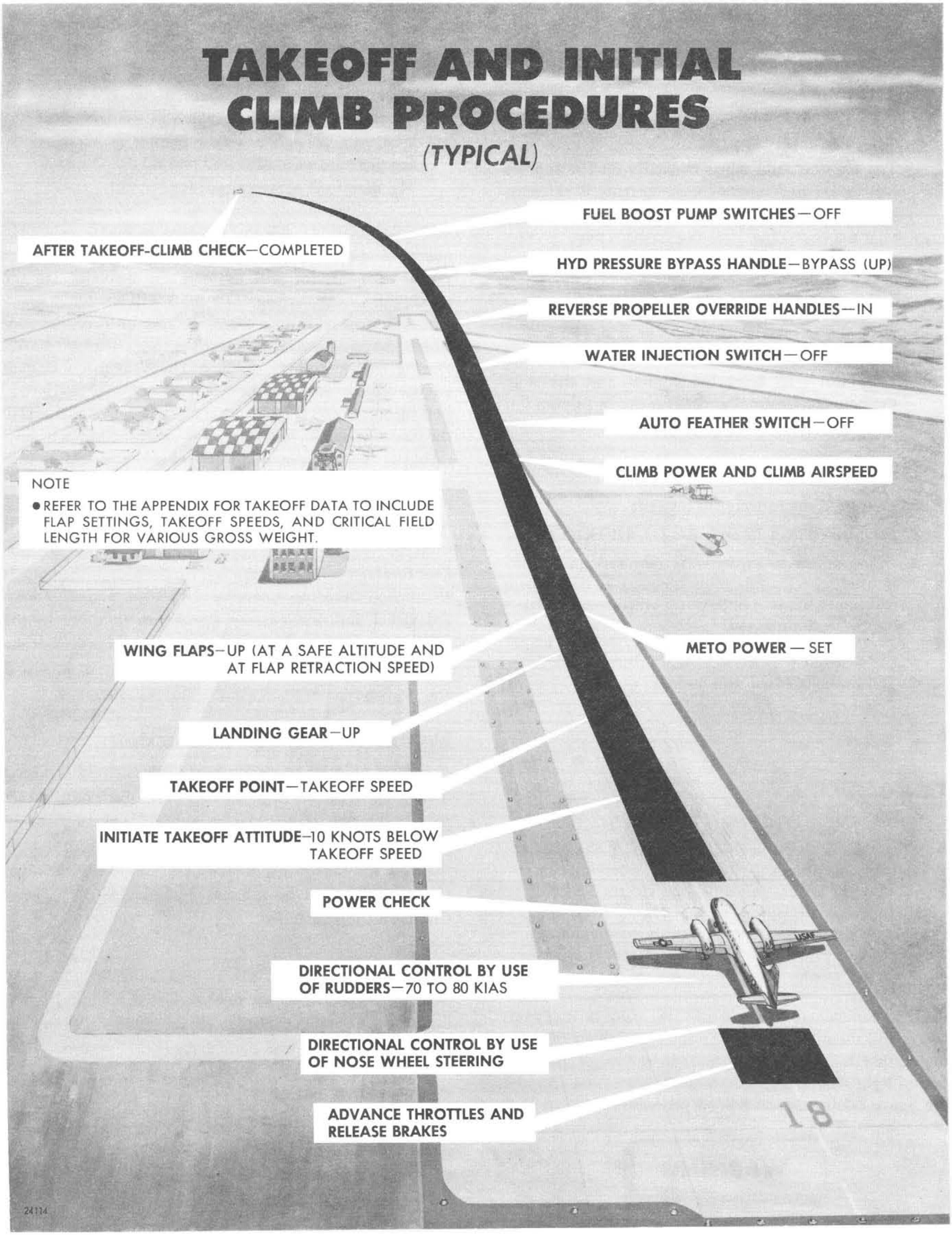
A takeoff without water injection differs from a takeoff with water injection only in that manifold pressures are restricted to the limits given in Section V. The dry takeoff ground roll will be approximately 12 percent longer than the wet takeoff ground roll and single-engine initial rate of climb will be greatly reduced. See the Takeoff Charts in the Appendix.

MINIMUM TAKEOFF RUN

Set wing flaps at 24° for takeoff. Use the normal procedure except obtain maximum power before releasing the brakes and starting the takeoff run.

CROSS-WIND TAKEOFF

In light-to-moderate cross-winds, use normal takeoff technique. In extreme cross-winds, hold the airplane nose on the ground slightly longer than normal and break from the ground cleanly. Use cross-controlling as necessary. Refer to Appendix I, Takeoff and Landing Cross-Wind Chart.



TAKEOFF AND INITIAL CLIMB PROCEDURES

(TYPICAL)

AFTER TAKEOFF-CLIMB CHECK—COMPLETED
FUEL BOOST PUMP SWITCHES—OFF
HYD PRESSURE BYPASS HANDLE—BYPASS (UP)
REVERSE PROPELLER OVERRIDE HANDLES—IN
WATER INJECTION SWITCH—OFF
AUTO FEATHER SWITCH—OFF
CLIMB POWER AND CLIMB AIRSPEED
METO POWER — SET
WING FLAPS—UP (AT A SAFE ALTITUDE AND AT FLAP RETRACTION SPEED)
LANDING GEAR—UP
TAKEOFF POINT—TAKEOFF SPEED
INITIATE TAKEOFF ATTITUDE—10 KNOTS BELOW TAKEOFF SPEED
POWER CHECK
DIRECTIONAL CONTROL BY USE OF RUDDERS—70 TO 80 KIAS
DIRECTIONAL CONTROL BY USE OF NOSE WHEEL STEERING
ADVANCE THROTTLES AND RELEASE BRAKES
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NOTE

- REFER TO THE APPENDIX FOR TAKEOFF DATA TO INCLUDE FLAP SETTINGS, TAKEOFF SPEEDS, AND CRITICAL FIELD LENGTH FOR VARIOUS GROSS WEIGHT.

Figure 2-5

OBSTACLE CLEARANCE

Set wing flaps at 24° for takeoff. Use minimum takeoff run procedure. Do not attempt to force the airplane off the ground. Maintain maximum power and airspeed. Leave the wing flaps down. After the obstacle is cleared, level off and gain speed. Retract wing flaps in accordance with figure 3-4.

AFTER TAKEOFF—CLIMB

Climb at the speed specified in Appendix I, and with the nacelle flaps set to the midposition.

Note

- For typical takeoff and initial climb procedures see figure 2-5.
- This speed and nacelle flap setting provides sufficient cooling for hot summer temperatures. Nacelle flaps should normally be open only as necessary to maintain cylinder head temperatures within limits.
- At high gross weights, operating below the minimum climb speed may result in stall warning buffeting.

① Landing gear lever – UP. (CP)
When definitely airborne retract the landing gear. The landing gear unsafe light will remain illuminated while the gear is in transit, then go out as the position indicators show a tab up indication.

CAUTION

If vibration is noticed on takeoff, brake wheels lightly after takeoff to preclude possible damage to the nacelle or uplocks from loose tread or unbalanced wheels.

Note

Landing gear retraction must begin immediately after takeoff to prevent undue stresses on the retraction mechanism. Refer to Section V for landing gear limitations.

② Wing flaps switch – UP. (FM)
At a safe altitude and at flap retraction speed, the flight mechanic will retract the wing flaps on command of the pilot.

③ Power – Set. (CP)
After reaching a safe altitude and climb airspeed, the copilot will set power. In high density areas, the flight mechanic may make the power reduction from METO to climb power.

a. Power – METO.
b. Power – Climb.

4. Autofeather switch – OFF. (CP)
5. Water injection switch – OFF. (CP)

Note

- Water will continue to flow at climb power. Water injection should be turned off after power reduction to conserve water.
- Shutting off water injection results in carburetor fuel enrichment. This is indicated by an increase in the fuel flow.

6. Reverse propeller override indicator handles – In, lights out. (FM)
If the red portion of the shaft is still visible, push the handle in. The indicator light should go out.

WARNING

If, due to malfunction of the electrical circuit, the override handles will not remain in after takeoff, the propeller reverse lock circuit breaker should be pulled out in order to assure that the throttle quadrant stops will be in effect during the flight. Manually operate the reverse handles after landing.

7. Hydraulic pressure bypass handle–BYPASS (UP). (FM)
Pull the hydraulic pressure bypass handle up to the BYPASS position.

Note

If one or more of the landing gear is not up and locked, the gear will again extend as the hydraulic pressure bypass handle is raised to the BYPASS position. Gear extension will be indicated by illumination of the landing gear-unsafe light as the gear is extending and a change of tabs in the landing gear position indicators. A jar may also be apparent as the gear is snapped down by the slipstream.

8. Fuel booster pump switches – OFF. (FM)
Turn switches OFF, one at a time, at a safe altitude (1000 feet). Check fuel pressure fluctuation when the switches are turned OFF.

CAUTION

Fuel booster pumps may be used at altitudes above 10,000 feet. Turn on the fuel booster pumps at any time fuel pressure fluctuates within the normal range, or if the pressure-low warning light flickers. Do not turn pumps on if fuel pressure drops below limits and engines continue to operate normally.

9. Engine and wings – Checked. (FM)
10. "Seat Belt" and "No Smoking" signs–As required. (P)
⑪ Cabin altitude – Set. (FM)
12. Engine analyzer check – Completed. (FM)
13. After takeoff climb check – Completed. (FM)

CLIMB

Climb speed with wing flaps retracted is 145 KIAS. Set the mixture control levers in AUTO RICH. Set the nacelle flaps at the midposition. With this procedure, you will be able to obtain the results set forth in the Climb Charts in the Appendix. Refer to the Appendix for climb and cruise charts.

Note

> This speed and nacelle flap setting provides sufficient cooling for hot summer temperatures.

CRUISE

The nacelle flaps should be kept as nearly closed as possible in normal flight to reduce drag. Refer to the Appendix for cruise power settings. Refer to Section VII for proper management of mixture, nacelle flaps, booster pumps, and spark plug defouling procedures.

FLIGHT CHARACTERISTICS

Refer to Section VI, FLIGHT CHARACTERISTICS.

DESCENT

For best approach speeds at various gross weights and altitudes, refer to the Appendix. In making normal descent from cruising altitude, reduce power as required to maintain desired airspeed and rate of descent. Maintain cylinder head temperatures within normal operating limits.

CAUTION

> Avoid prolonged use of high rpm with low manifold pressure. Maintain a minimum power setting of one inch Hg manifold pressure per 100 rpm to avoid engine damage. If flying conditions in a descent require a large reduction in power, reduce rpm as well as manifold pressure. It is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure.

Adjust mixture as required and monitor cabin pressure scheduling. Shift to low blower at the appropriate altitude.

Phase I of the descent checklist may be accomplished as required during descent; however, Phase II items must be checked before entering the downwind leg of the traffic pattern.

PHASE I

1. Crew and passenger briefing–Completed. (P)
   The pilot will brief the copilot and crew to ensure they know their duties during the approach and landing. Refer to Section VIII for passenger briefing checklist.
② Cabin altitude – As required. (CP)
3. Hydraulic fluid quantity – Checked. (FM)
4. Hydraulic pressure bypass handle – PRESS (DWN). (FM)
5. Hydraulic and air pressure gages – Checked. (FM)
   Check hydraulic and emergency air system pressure gages for pressure within the normal range.
6. Blower switches – LOW. (FM)
   Engine blowers may be shifted from HIGH to LOW position during descent with mixture control levers in the manual lean or AUTO LEAN position.
7. Mixture control levers – As required. (CP)
   Descent may be accomplished with mixture control levers in manual lean or AUTO LEAN.
8. Fuel controls – Normal. (FM)
9. Reverse propeller override indicator handles–In. (FM)
   Check that the reverse override handles are in. If the red portion of the shaft is visible, pull the prop reverse lock circuit breaker. It will be necessary to manually operate the handles on landing.
10. Circuit breakers – Checked. (FM)

PHASE II

11. Seat belt and no smoking signs – On. (P)
12. Safety belt and shoulder harness – Adjusted. (ALL)
13. Fuel booster pump switches – ON. (FM)
    Place the left and right fuel booster pump switches in the ON position and check that the fuel pressure is within normal limits.
14. Augmentor vane switches – Climatic. (FM)
    Check the augmentor vane indicators. Normally, the augmentor vanes should be in trail except when wing heat is required.

CAUTION

> If augmentor vanes are used during descent, care should be used to prevent exceeding desired cylinder head temperature.

15. Mixture control levers – AUTO RICH. (CP)
16. Carburetor heat control levers – Climatic. (FM)

Check that the carburetor heat control levers are in the COLD position unless icing conditions require the application of heat.

CAUTION

If carburetor heat is being used and a go-around is necessary, carburetor air temperature must not be allowed to exceed maximum limits.

17. Descent check – Completed. (FM)

BEFORE LANDING

Note

The before landing check may be performed before, but in no case later than the point indicated on figure 2-6.

(1.) Propellers – 2400 rpm. (CP)

(2.) Wing flaps – Approach setting. (FM)

Note

Refer to Appendix I, for approach and landing flap settings at various gross weights and altitudes.

(3.) Landing gear lever – DOWN and locked. (CP)

Extend the gear by moving the landing gear lever to the DOWN position. The landing gear unsafe red warning light will illuminate and remain on until the three position indicators show gear down and locked. The warning light will then go out. Check that the brake hydraulic pressure and the emergency air brake pressure are within limits. Check that the index marks on the nose steering wheel are aligned with the index marks on the pilot's console.

CAUTION

Do not lower the landing gear at speeds in excess of the airspeed limit. The gear actuating mechanism and supporting structure are not designed for the air loads that would be imposed if the gear were lowered at a greater airspeed.

Note

If the throttles are retarded to a low power setting before the landing gear has been lowered, the gear unsafe warning horn will sound.

(4.) Water injection switch – ON. (CP)

Place the water injection switch in the ON position if sufficient quantity of water remains for a go-around.

CAUTION

- If the water injection tank has less than seven gallons of fluid remaining, a switch in the quantity transmitter opens the power circuits to prevent use of water injection as there is not enough water left to complete a wet power go-around.
- If a go-around is necessary and water pressure is below limits, turn off the water injection switch to ensure proper mixture.

5. Before landing check Completed. (FM)

LANDING

For a typical normal landing pattern, see figure 2-6.

Note

Landing distances shown in the Appendix are based on the techniques described here, with the exception that the effect of aerodynamic braking by use of propeller reverse thrust is not reflected in the chart data. Efficient use of reverse thrust will shorten the landing roll appreciably.

NORMAL LANDING

After the final approach configuration has been established, reduce airspeed to approximately 1.3 stall speed minimum. When the landing is assured:

(1.) Wing flaps – Landing setting. (FM)

Extend the wing flaps to the appropriate angle for the landing depending on field length and gross weight factors.

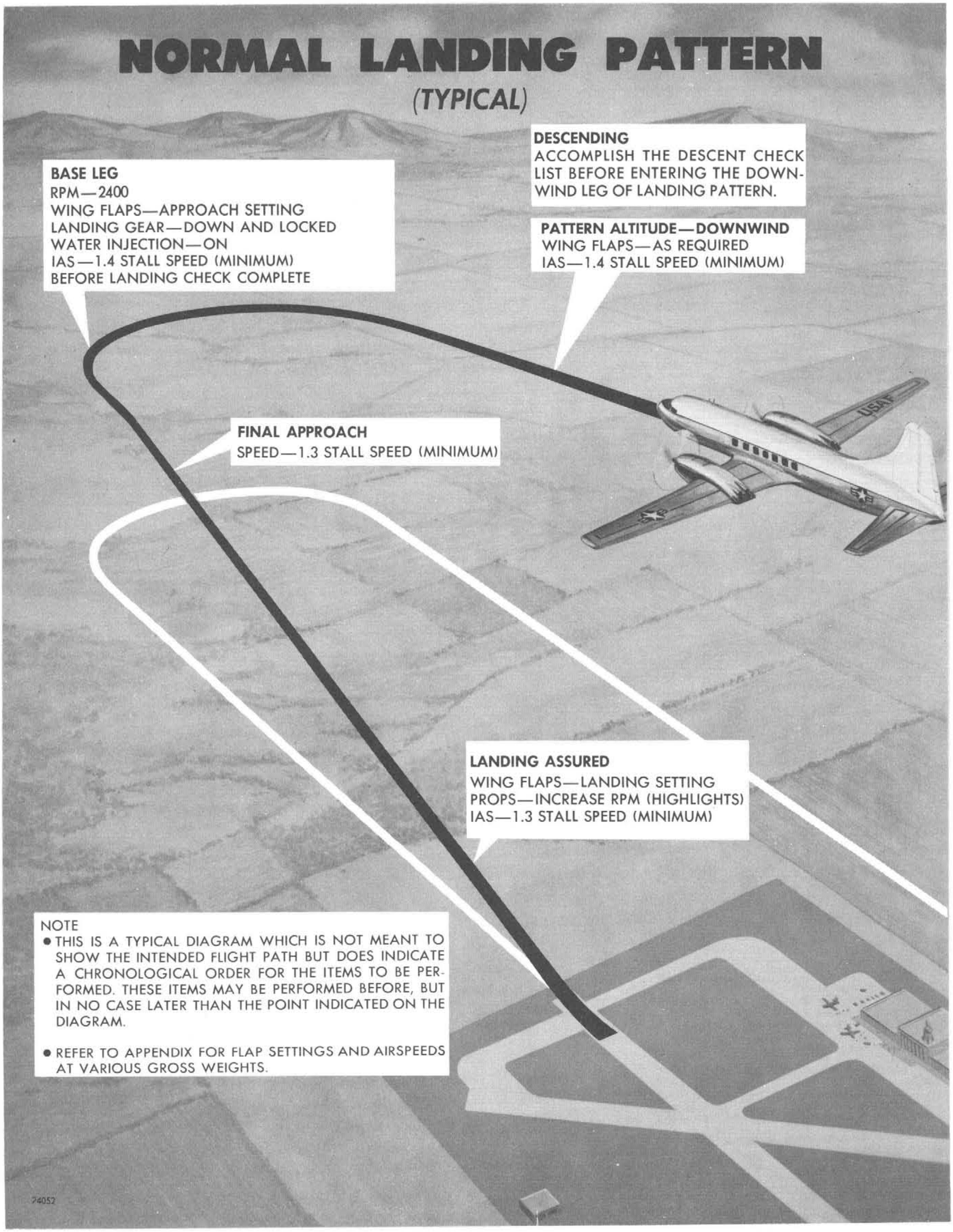
(2.) Propeller speed control levers – INCREASE RPM (high lights). (CP)

Hold the propeller speed control levers in the INCREASE RPM position until the governor limit indicator lights illuminate.

Better controlled landings can be made by maintaining positive thrust during landing flare and touchdown. After the airplane settles on the landing gear, the reverse propeller override handles will pop out. If the handles do not pop out automatically the copilot pulls them out. After the nose wheel is on the ground the pilot pulls the throttles aft into reverse thrust range for aerodynamic braking, and the flight mechanic retracts the wing flaps. The pilot uses nose wheel steering to maintain directional control.

NORMAL LANDING PATTERN

(TYPICAL)



DESCENDING
ACCOMPLISH THE DESCENT CHECK LIST BEFORE ENTERING THE DOWNWIND LEG OF LANDING PATTERN.

BASE LEG
RPM—2400
WING FLAPS—APPROACH SETTING
LANDING GEAR—DOWN AND LOCKED
WATER INJECTION—ON
IAS—1.4 STALL SPEED (MINIMUM)
BEFORE LANDING CHECK COMPLETE

PATTERN ALTITUDE—DOWNWIND
WING FLAPS—AS REQUIRED
IAS—1.4 STALL SPEED (MINIMUM)

FINAL APPROACH
SPEED—1.3 STALL SPEED (MINIMUM)

LANDING ASSURED
WING FLAPS—LANDING SETTING
PROPS—INCREASE RPM (HIGHLIGHTS)
IAS—1.3 STALL SPEED (MINIMUM)

NOTE

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED. THESE ITEMS MAY BE PERFORMED BEFORE, BUT IN NO CASE LATER THAN THE POINT INDICATED ON THE DIAGRAM.
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.

Figure 2-6

Note

- A secondary solenoid-actuated stop on the throttle prevents power application in reverse thrust range if the corresponding propeller fails to reach approximately full reverse pitch.
- The nacelle flaps should be fully closed during prolonged reverse thrust operation and then opened fully after reverse thrust operation to assist in ground cooling.
- When reverse thrust is used, some control surface buffet may occur. The copilot should hold the controls.

When the airplane has lost most of its forward speed the pilot moves the throttles to the normal power-off detent while applying the brakes lightly. The flight mechanic opens the nacelle flaps. To allow sufficient time for brakes to cool when they are used as the only means of stopping the airplane during landing, it is recommended that at least 15 minutes elapse between landings when the gear is extended, and a minimum of 30 minutes when the gear is retracted. Added time should be allowed for cooling if brakes are used for steering or cross-wind taxiing, or if a series of landings are made. Refer to USE OF BRAKES, Section VII.

MINIMUM RUN LANDING

Use the same procedure as for a normal landing except that brakes may be applied over a greater portion of the landing roll. Retract the wing flaps immediately after contact in order to permit the airplane to settle its weight upon the landing gear more rapidly to increase braking effectiveness. Use reverse thrust as effectively as possible.

CROSS-WIND LANDING

Landings and takeoffs have been made in 90° crosswinds of 30 knots with no unusual or dangerous characteristics. Refer to the Appendix for Takeoff and Landing Cross-Wind Chart.

TECHNIQUE FOR CROSS-WIND LANDINGS

After the turn to final approach is made, lower the upwind wing and apply opposite rudder to counteract drift and maintain a straight track down the center of the runway.

CAUTION

Cross control pressures required to maintain a straight line track over the runway are greater than for most airplanes due to the spring tension on the rudder-aileron interconnect.

Maintain the wing-low attitude throughout the final approach and flare. Maintain pressure on the upwind aileron after the gear touches the ground.

Note

If conditions warrant, a combination of cross control and crab can be employed during the approach phase but all crab must be eliminated prior to touchdown.

CAUTION

If the airplane is crabbed or drifting at the moment of ground contact, excessive stresses may be imposed on the landing gear.

Retract wing flaps immediately upon touchdown. Use rudder for directional control until nose wheel touches down, then use nose wheel steering for directional control. Hold the upwind aileron pressure until airplane has completed landing roll.

ZERO WING FLAP LANDING

For a zero wing flap landing, maintain approximately 1.3 stall speed on the approach keeping a slight amount of power on the engines. Too much power will result in a pronounced nose-high attitude which must be avoided. Close the throttles after the landing flare, and decelerate normally, using reverse thrust.

HIGH GROSS WEIGHT LANDINGS

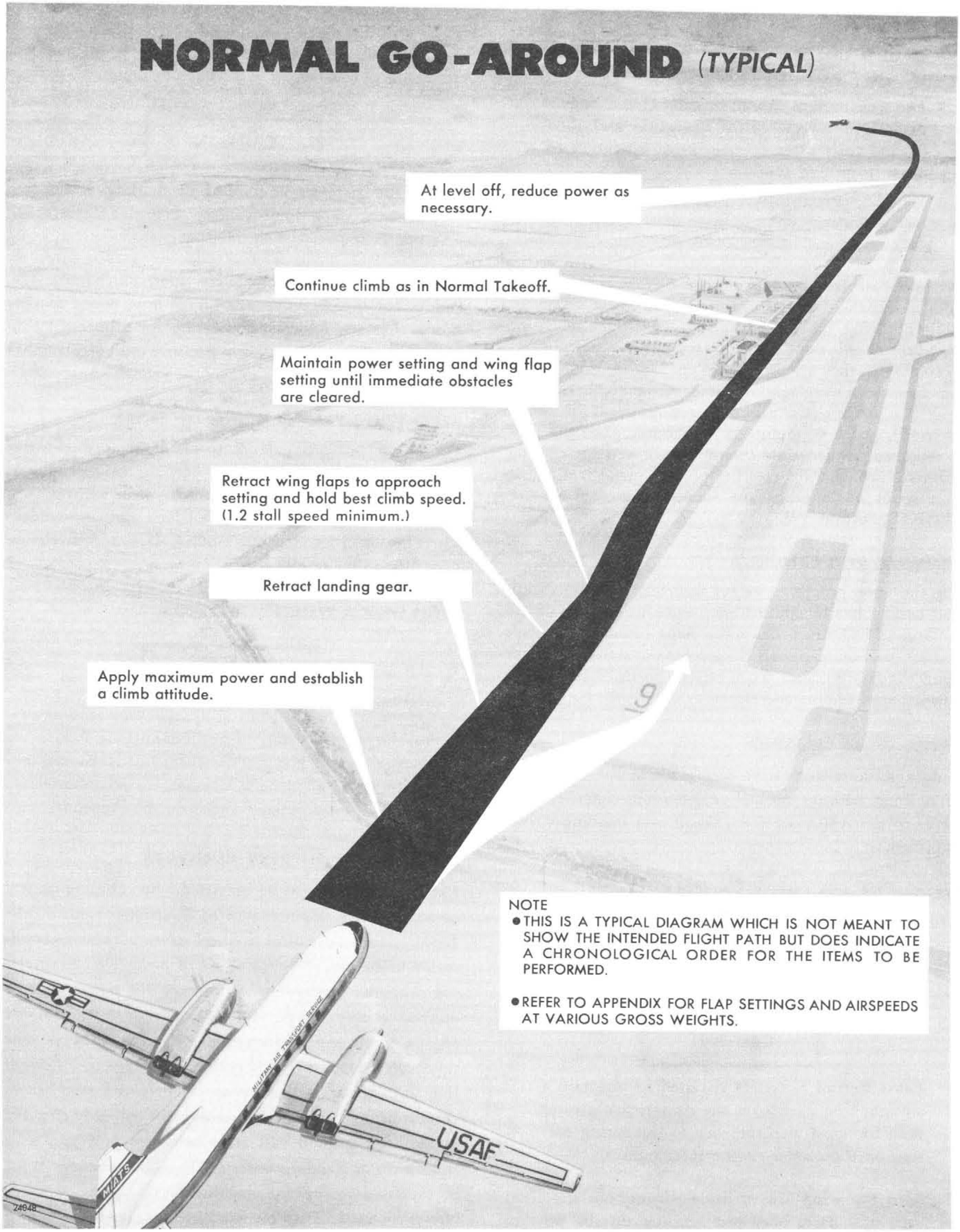
CAUTION

If an engine fails during approach or landing at high gross weights or high-altitude fields, adequate single-engine performance is assured only if the airplane is operated in accordance with the performance charts in the Appendix.

LANDING ON SLIPPERY RUNWAYS

Extreme caution must be exercised when landing on wet or icy runways. Maintenance of directional control calls for a combined use of nose wheel steering, cautious application of brakes, and careful use of power. When reversing propeller pitch on an icy runway, the power must be applied evenly to prevent unbalanced thrust on one engine from causing the airplane to slide sideways. The nose wheel alone will not hold the airplane in a straight line and power will have to be balanced whether in reverse or normal pitch. Reverse thrust is highly effective in reducing ground roll after landings; however, with light snow or standing water on the runway, caution must be exercised to prevent visibility loss by snow or water blown forward. Turn on windshield wiper before using reverse thrust. Apply reverse thrust immediately after

NORMAL GO-AROUND *(TYPICAL)*



At level off, reduce power as necessary.

Continue climb as in Normal Takeoff.

Maintain power setting and wing flap setting until immediate obstacles are cleared.

Retract wing flaps to approach setting and hold best climb speed. (1.2 stall speed minimum.)

Retract landing gear.

Apply maximum power and establish a climb attitude.

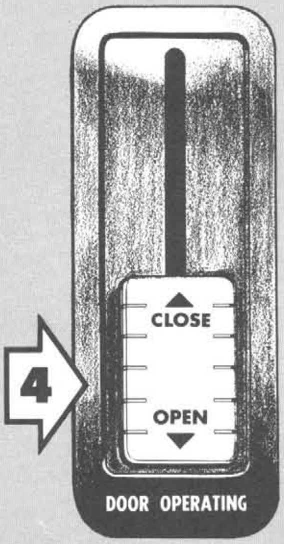
NOTE

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED.
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.

Figure 2-7

OPENING ENTRANCE DOOR

FROM INSIDE

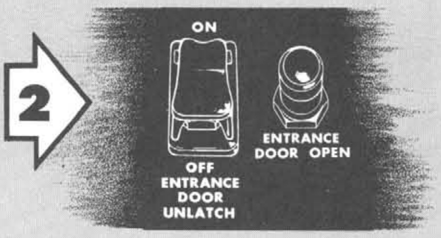


1 Move secondary lock handle to the OPEN position . . . .

2 Hold entrance door unlatch switch to ON position until Step 3 has been completed . . . . .

3 Pull primary lock lever to the OPEN position . . . .

4 With hydraulic pressure bypass handle in PRESS. move door-operating handle to OPEN position .



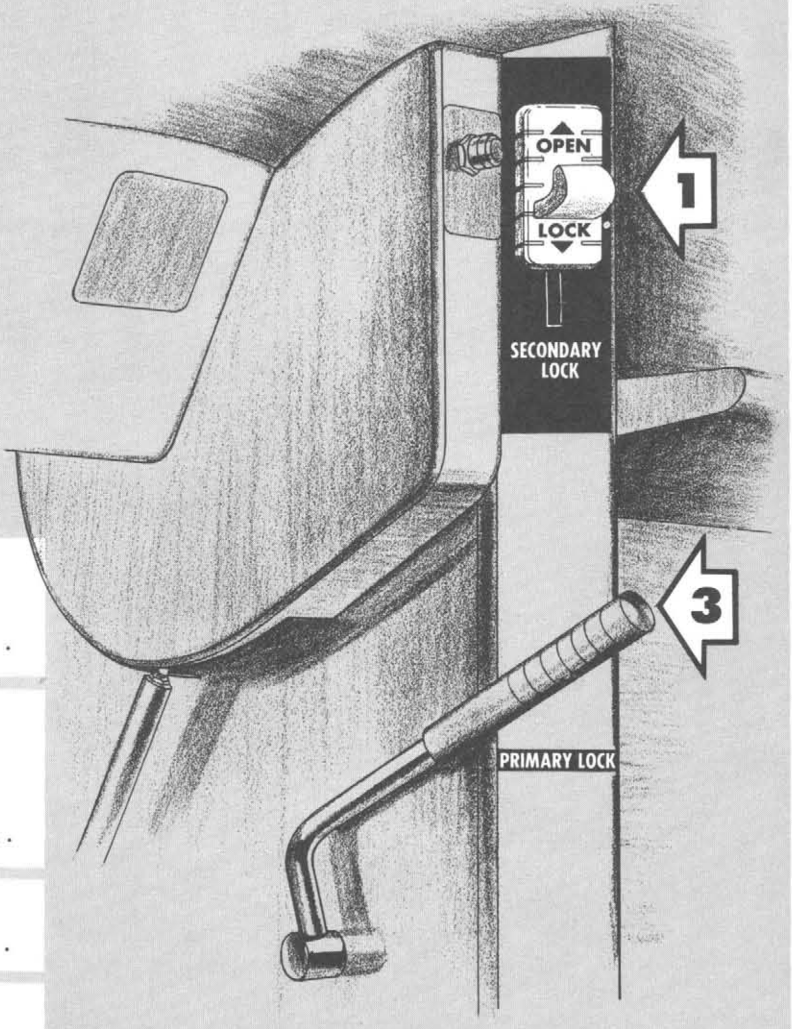


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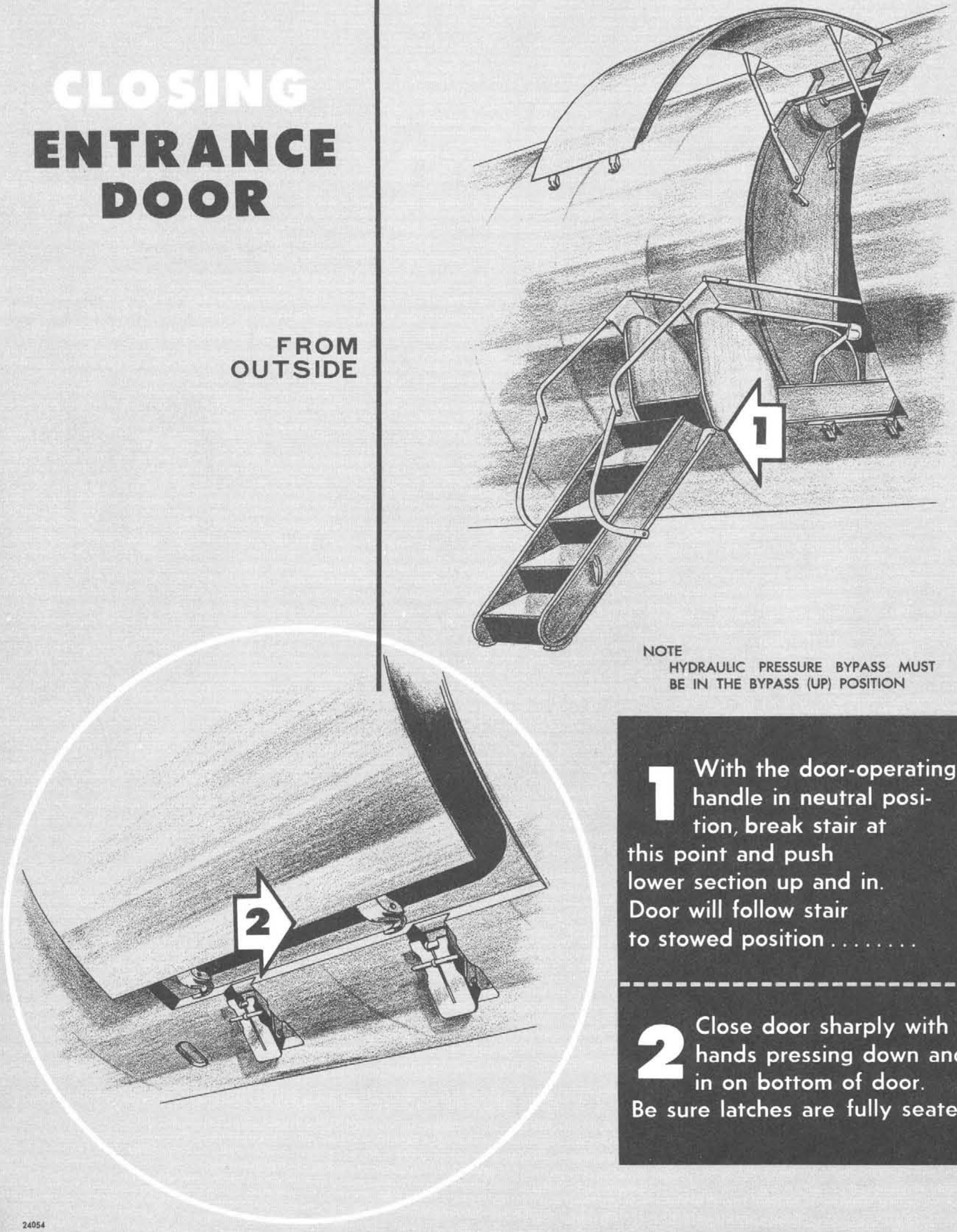
Figure 2-8

CLOSING ENTRANCE DOOR

FROM OUTSIDE



NOTE
HYDRAULIC PRESSURE BYPASS MUST BE IN THE BYPASS (UP) POSITION

1 With the door-operating handle in neutral position, break stair at this point and push lower section up and in. Door will follow stair to stowed position . . . .

2 Close door sharply with hands pressing down and in on bottom of door. Be sure latches are fully seated

Figure 2-9

touchdown, reducing power as speed is lost. With proper use of reverse thrust, forward visibility can be maintained in all but very fluffy snow.

WARNING

- If airplane has a visible accumulation of ice, approach speed should be 1.4 stall speed (minimum) and touchdown speed should be 1.2 stall speed (minimum).
- Do not use brakes when landing on an icy runway. They will be ineffective during initial landing roll.

GO-AROUND

In the event of a go-around, advance the throttles to maximum power. Retract the gear and raise the wing flaps to approach setting and simultaneously adjust airspeed to best climb speed for the flap setting. Then retract the flaps in the normal manner. Compensate out-of-trim condition by use of the control column until trim tab setting can be readjusted. See figure 2-7 for typical go-around procedure.

AFTER LANDING—CLEAR OF RUNWAY

1. IFF/SIF – OFF/STANDBY. (CP)

   Turn IFF/SIF off as soon after landing as possible. This will eliminate signals from taxiing or parked airplanes which would interfere with radar control of airborne airplanes.
2. Generator loadmeters – Load off. (FM)

   Note

   An abnormally high loadmeter reading may indicate that a propeller feathering pump is still operating and the propeller is feathered or in reverse.
3. Wing flap switch – UP. (FM)
4. Fuel booster pump switches – OFF. (FM)

   Check for a fuel pressure fluctuation as the switches are turned off.
5. Nacelle flap switches – OPEN. (FM)
6. Water injection switch – OFF. (FM)

   Observe that the water pressure-on indicator lights go out.
7. Copilot's console – As required. (CP)
8. Load monitor switch – OVERRIDE. (FM)
9. After landing check – Completed. (FM)

POSTFLIGHT ENGINE CHECK—LAST FLIGHT OF THE DAY

Accomplish the following checks after the last flight of the day:

1. Parking brakes – Set. (P)
2. Engine power check – Completed. (P)

   Perform an engine power check in accordance with the procedure in ENGINE RUNUP, this Section.
3. Ignition system check – Completed. (FM)

   Check the ignition system in accordance with the procedure in ENGINE RUNUP, this Section.
4. Idle speed and idle mixture check – Completed. (FM)
   a. Close the throttle and check for an idle speed of 650 (±50) rpm.
   b. At 800 rpm, move the mixture control lever slowly and smoothly toward IDLE CUTOFF and carefully observe the tachometer for any change in rpm during this leaning procedure.

   Note

   "Slowly" may be defined as the rate of movement which would require 12 to 15 seconds to move the mixture control lever from AUTO-RICH to IDLE CUTOFF position. This slow movement of the lever is necessary so that the engine can respond to the change in fuel-air ratio and an accurate reading can be obtained as the best power mixture is reached.

   c. If a rise of more than 20 rpm or a drop in manifold pressure exceeding ½ inch Hg is noted, the idle rpm mixture fuel-air ratio is too rich. If no rise in rpm is noted, the idle rpm fuel-air ratio is too lean. After maximum rpm has been obtained and rpm starts to decrease with further movement of the mixture control, return the mixture control to AUTO-RICH position.
5. Ignition switch check – Completed. (FM)

   Perform an ignition switch check in accordance with the procedure in BEFORE TAXIING, this Section.
6. Postflight check – Completed. (FM)

ENGINE SHUTDOWN

Note

If a check of the right engine-driven hydraulic pump is desired, shut down the left engine and perform a hydraulic pump check by lowering flaps and observing hydraulic pressure gage.

1. Parking brakes – Set. (P)
2. Oil dilution – As required. (P)

   Refer to OIL DILUTION PROCEDURES, Section IX.

3. Throttles – 1000 rpm. (P)
   Advance the throttles to obtain approximately 1000 rpm to clear cylinders. Hold 1000 rpm for 30 seconds to scavenge the oil sump.

④ Mixture control lever, right engine – IDLE CUT-OFF. (CP)

5. Ignition switch, right engine – OFF. (CP)
   Place the RH ignition switch to OFF after the engine stops rotating.

⑥ Main entrance door – Open. (FM)

WARNING

The main entrance door will remain closed until the right engine has been shut down and the propeller has stopped turning.

⑦ Mixture control lever, left engine – IDLE CUT-OFF. (CP)

⑧ Ignition switch, left engine – OFF. (CP)
   Place the LH ignition switch to OFF after the engine stops rotating.

9. Anticollision light – OFF. (CP).
10. Engine shutdown check – Completed. (FM)

BEFORE LEAVING AIRPLANE

1. Ignition switches – OFF. (CP)
2. Radios – OFF. (CP)
3. Lights – As required. (ALL)
4. Cabin heat and vent switch – OFF. (CP)
5. Inverter selector switch – OFF. (CP)
6. Battery switch – As required. (CP)
   Normally the battery switch should be placed to OFF.
7. Alternator switches – OFF. (CP)
8. Flight controls – Locked. (P)
9. Trim tab position indicator – Set at 0°. (P)
10. Wheel chocks – In place. (P-CP)
    The pilot requests the ground crew to put the wheel chocks in place.
11. Parking brakes – As required. (P)
    When it is ascertained that the wheel chocks are in place, the pilot releases the parking brakes unless it is otherwise required to leave them set.
12. Engine analyzer – OFF. (FM)
13. Landing gear pins – Installed. (FM)

CAUTION

In addition to established requirements for reporting any system defects or unusual and excessive operations, the flight crew will also make entries on Form 781 to indicate when any limits in the Flight Manual have been exceeded.

Note

If the airplane is to be secured for an extended period, place the hydraulic pressure bypass handle in the BYPASS (UP) position.

14. Before leaving airplane check – Completed. (FM)

CLOSING ENTRANCE DOOR

See figure 2-9.

CAUTION

If the door does not readily begin to close as the stair is folded upward, do not force the stair to fold further. Extend the stair and investigate the door hold-open struts and hold-open stop (on the entrance aft bulkhead) for incorrect adjustment.

Section III

EMERGENCY PROCEDURES

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INTRODUCTION

This Section contains what experience has shown to be the best procedures in meeting various emergencies that may be encountered. Each emergency presents a different problem, but a thorough knowledge of the procedures contained in this Section will enable a pilot to better cope with any emergencies. The pilot, as soon as practical after encountering an emergency and after completing initial corrective action, shall establish communications with the ground station which he is monitoring at the time. There has been a tendency in the past, on the part of the pilot, to minimize certain disorders that could become serious. This practice is not consistent with safety as there may be insufficient time later to alert the agencies that can help. Once an emergency call has been channeled to Air Rescue Service and other agencies, a diligent and constant check on the subsequent progress of the flight is maintained. Include a complete description of the trouble in the original message. This enables rescue agencies to make early preparations and computations in connection with their responsibilities. Place emphasis on accurate position reporting. Keep the ground station notified at all times of any changes or developments in the emergency, and inform them of action taken.

Note

- Although many inflight emergencies require immediate corrective action, difficulties are frequently compounded by the tempo of the pilot's commands and hurried execution by the crew. It is essential that the pilot carefully analyze the difficulty prior to taking corrective action.
- The urgency of certain emergencies requires immediate and instinctive action by the aircrew member. These check list items are in bold print and shall be memorized by the crew member. Following completion of the bold print items, the remaining portion of the check list will be completed in its entirety, time permitting.

SINGLE-ENGINE OPERATION

Note

During single-engine operation, added attention must be given to single-engine emergency operating procedures to avoid compounding an emergency. It is important to remember the information outlined in the following paragraphs.

Performance

Single-engine performance is reduced during operations at or approaching Air Force Hot Atmosphere conditions. Pilots must be continually aware that single-engine absolute, service, and cruise ceilings, as well as single-engine go-around capabilities, are reduced significantly under high ambient temperature conditions. The performance reduction is of particular concern when operating over or from high ground elevations.

Maintaining Controlled Flight

Maintaining control of the airplane, including required drag reduction, during all emergency procedures is axiomatic to all airplane flight operations and is vital during single-engine maneuvers at low altitudes. Gear retraction on go-around, one engine inoperative, is a normal requirement and is imperative while operating at above standard temperatures or at high ground elevations. Flap management also is important to drag reduction and must receive proper consideration.

Reduction of Electrical Load

Reduction of the electrical load to minimize the possibility of failure of the remaining generator, or alternator, during single-engine operations must not be overlooked. Reduction of the load *prior to* engine shutdown during practice maneuvers is a major safety precautionary measure. Electrical loads should be reduced to less than the normal rated capacity of the remaining generator before practice engine shutdown. The practice shutdown procedure normally should be that for FUEL PRESSURE DROP DURING FLIGHT—ENGINE OPERATING NORMALLY. This procedure induces fewer stresses in the engine, which in itself is a safety measure.

Electrical Power Loss

Complete dc power loss as a result of failed or nonoperating generators can be a contributing factor in compounding an emergency. Pilots must familiarize themselves with the airplane systems and instruments so that, under the stress of an emergency, erroneous or unreliable indications from monitoring instruments will not result in pilot actions which compound the emergency. It is to be particularly noted that the landing gear and flap position indicators are unreliable as a result of dc power loss.

Landing

During landings with one engine inoperative, plan the approach and the landing gear and flap extension so that consideration may be given to emergency gear or flap extension, if required. The gear and flaps should not be extended until the final stages of the approach; however, the exact point for gear extension must be left to the discretion of the pilot and will be based on the known condition of the airplane at the time.

FLIGHT CHARACTERISTICS UNDER SINGLE-ENGINE OPERATION

During low-speed single-engine flight, keep the wing on the inoperative engine side approximately 3° high, using a minimum amount of rudder. As airspeed is decreased, additional rudder will be necessary to offset unbalanced thrust. Stall warning, in the form of buffeting, will occur approximately 13 KIAS above the stall speed with the airplane clean and approximately four to five KIAS above the stall speed with full flaps. (See figure 6-1.) If in a climb, severe rate-of-climb loss will result while remaining in this buffet range. Refer to PRE-STALL BUFFET, Section VI. For minimum safe single-engine speed with gear and flaps up, see figure 3-1.

Note

- Safe single-engine speed is defined as the speed that will permit the airplane to maintain 100 fpm rate of climb after clean configuration has been established and the propeller on the inoperative engine is feathered. This speed is based on sea level standard atmosphere, with maximum power on the operative engine. Operation on hot days and at higher altitudes will result in a deterioration of airplane performance. Refer to the Appendix for single-engine performance in other than standard atmosphere conditions.
- Minimum control speed is defined as the speed required to provide sufficient control to enable the airplane to fly a straight flight path when one engine has failed (sea level standard atmosphere). Minimum control speed is based on takeoff configuration, propeller windmilling on the inoperative engine, with maximum power on the operating engine and no more than 5° of bank angle away from the failed engine. It may be necessary to sacrifice altitude for airspeed while putting the airplane in a clean configuration and obtaining sufficient airspeed to climb. See figure 3-2 for minimum control speeds. Refer to PRACTICE OF MINIMUM CONTROL SPEED WITH ONE ENGINE WINDMILLING, this Section, for further information.

Directional Stability

Because of high directional stability it may be difficult to determine immediately which engine has failed. Rather than depending entirely on the feel of the airplane, and to avoid confusion as to which engine has failed, observe the torquemeter and fuel flow.

ENGINE FAILURE

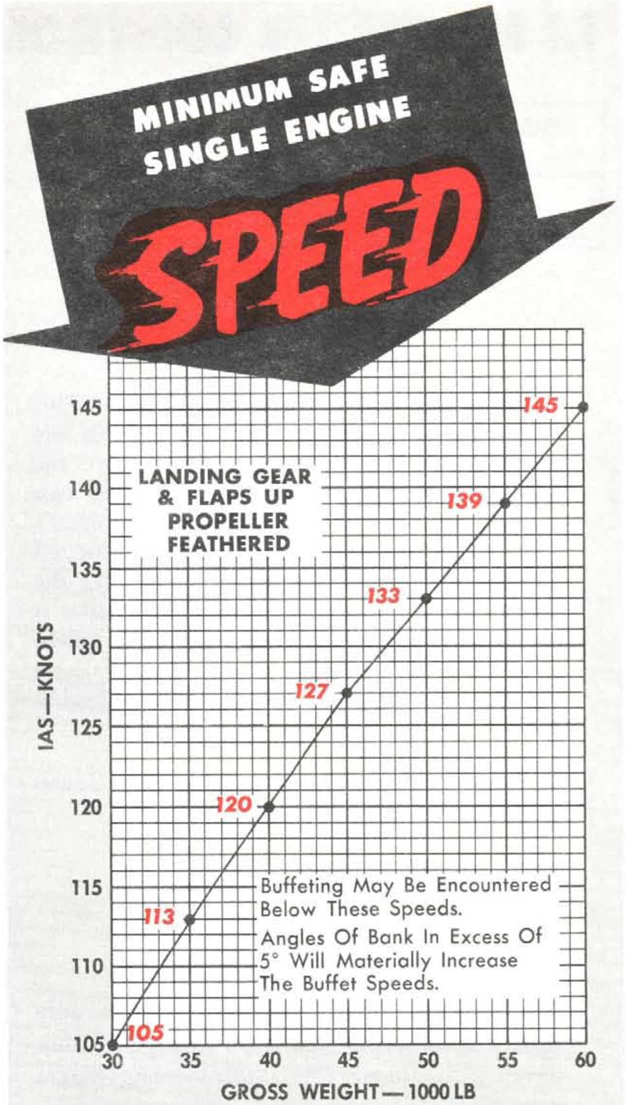
ENGINE FAILURE DURING TAKEOFF (BEFORE LEAVING GROUND)

If an engine failure occurs before refusal speed is attained, abort the takeoff. Refer to TAKEOFF AND LANDING EMERGENCIES, this Section.

ENGINE FAILURE DURING TAKEOFF (CONTINUED FLIGHT POSSIBLE)

Maintain Controlled Flight/Reduce Drag

If, on encountering engine failure during takeoff, it is decided to continue the takeoff, maximum power and directional stability must be maintained. The following items will be accomplished upon command of the pilot:



WARNING

FOR TAKE OFF AND LANDING WITH LANDING GEAR AND FLAPS DOWN, THE MINIMUM SAFE SINGLE ENGINE SPEED IS TAKE-OFF SPEED (V_2). REFER TO APPENDIX I, PART 3, FOR TAKE-OFF SPEEDS AT VARIOUS GROSS WEIGHTS AND FLAP SETTINGS.

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Figure 3-1

(a.) Landing gear lever – UP, after takeoff. (CP)

(b.) Flaps – As required. (FM)

Leave wing flaps at takeoff setting. Hold takeoff speed until obstacles have been cleared. Then, using flap management, increase airspeed to best climb for zero flaps. See figure 3-1 for minimum safe single-engine speed.

Note

- As the autofeather switch will normally be in the ON position for takeoff, the propeller of the

1.1 MINIMUM CONTROL SPEEDS

DENSITY ALTITUDE (FEET)	S.L.	5000	10000
IAS (KNOTS)	103	101	98

24062

Figure 3-2

failed engine will automatically feather. This feathering is indicated when the light in the propeller manual feathering button for the failed engine comes on and approximately two seconds later the feathering button automatically moves into the feather position. The red light in the manual feathering button for the failed engine will stay on until the propeller is feathered and the button pops out. The green autofeather indicator on the pedestal will go out at the completion of the autofeathering cycle.

- If failed engine has not automatically feathered, depress manual feathering button.

WARNING

The autofeathering system will operate only when engine power loss is the emergency condition encountered. The autofeathering system does not protect nor operate when emergency is an overspeeding propeller, engine fire, etc.

Engine Shutdown

Refer to ENGINE FAILURE DURING FLIGHT, this Section, for engine shutdown procedures.

ENGINE FAILURE DURING FLIGHT

Engine Shutdown/Maintain Controlled Flight

Maintain controlled flight. Hold the airplane straight and level, terrain permitting, and determine which engine has failed by observing the torquemeter and fuel flowmeters.

Note

Place mixture control in AUTO RICH, and adjust propeller control to 2600 rpm on operating engine, so that METO power will be available if the operating generator becomes inoperative with subsequent propeller control loss.

① **PROPELLER FEATHERING BUTTON — PUSH TO FEATHER.** (CP)

Note

While the propeller is feathering, accomplish power, gear, and flap changes as necessary. Complete the following shutdown actions accurately and promptly.

2. **MIXTURE CONTROL LEVER — IDLE CUT OFF.** (CP)
3. **ENGINE FLUID-OFF HANDLE — PULL OUT.** (CP)

Note

If the handle cannot be pulled out, it can be turned to free the fire extinguisher switch and guard.

4. **MAIN FUEL SHUTOFF VALVE SWITCH — OFF.** (FM)
5. **FUEL BOOSTER PUMP SWITCH — OFF.** (FM)
6. **NACELLE FLAPS SWITCH — CLOSED.** (FM)
7. **MANUAL HEAT ANTI-ICE SHUTOFF HANDLE — OFF.** (FM)
8. **FIRE EXTINGUISHER SWITCH — ON (IF FIRE EXISTS).** (CP)

WARNING

Discharge the fire extinguisher as soon as the engine stops or obviously will not slow down further.

Note

The fire extinguisher selector switch must be at the MAIN or RESERVE position in order to arm the fire extinguisher switches.

Clean Up Airplane

1. Generator switch (shutdown engine) – OFF. (FM)

② Electrical load – At minimum. (FM)

③ Load monitor switch – As required. (FM)

4. Alternator switch (shutdown engine) – OFF. (CP)

⑤ Alternator selector switch – As required. (CP)

6. Throttle (shutdown engine) – CLOSE. (CP)
7. Nacelle flap for operating engine – As required. (FM)
8. Ignition switch (shutdown engine) – OFF. (FM)

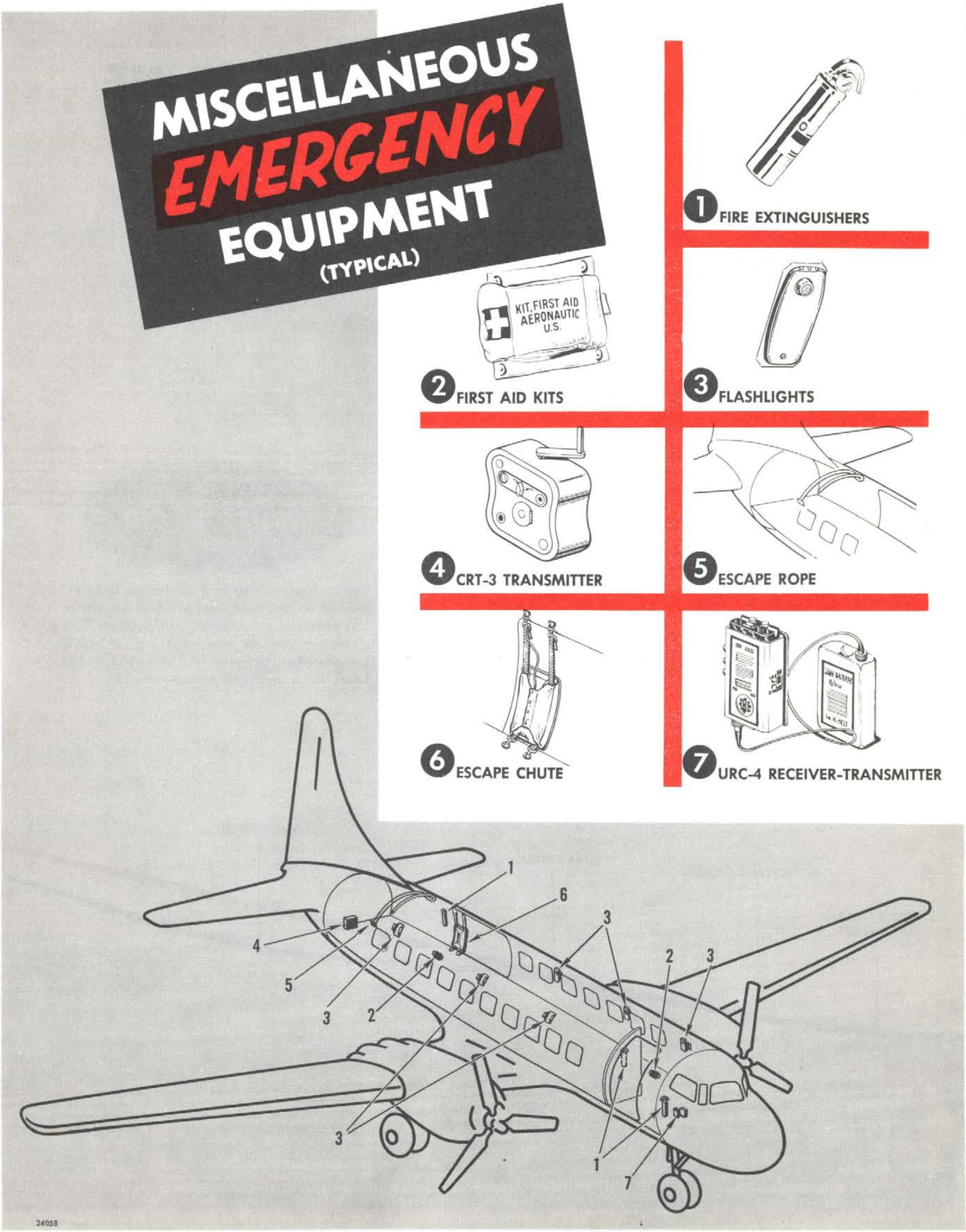

MISCELLANEOUS
EMERGENCY
EQUIPMENT
(TYPICAL)
1 FIRE EXTINGUISHERS
KIT, FIRST AID AERONAUTIC U.S.
2 FIRST AID KITS
3 FLASHLIGHTS
4 CRT-3 TRANSMITTER
5 ESCAPE ROPE
6 ESCAPE CHUTE
7 URC-4 RECEIVER-TRANSMITTER
1
6
3
4
2
3
5
3
2
3
1
7
24058

Figure 3-3

SINGLE ENGINE

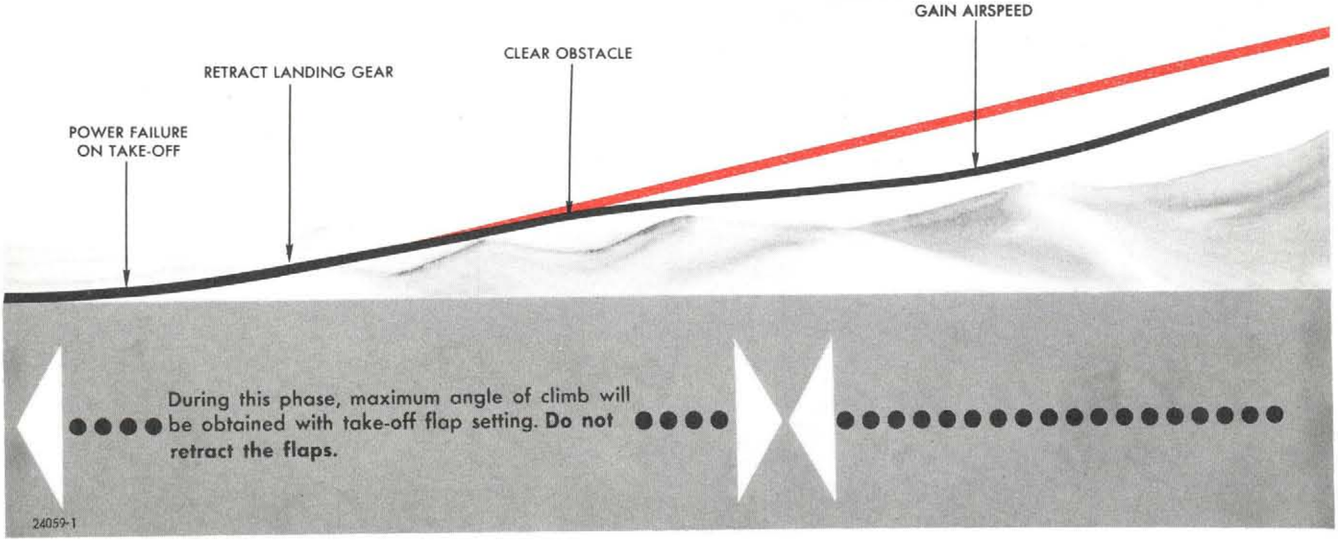
MINIMUM AIRSPEED FOR WING FLAP SETTINGS					
PROPELLER FEATHERED	WING FLAP SETTINGS				
	24°	20°	12°	6°	0°
TAKE-OFF WEIGHT IN POUNDS	AIRSPEED KNOTS IAS				
34,000	103	103	103.3	107	111.6
35,000	103	103	104.7	108.4	113.1
36,000	103	103	105.9	109.8	114.6
37,000	103	103	107.2	111.2	116
38,000	103	103.9	108.5	112.6	117.4
39,000	103	105.1	109.8	114.1	118.8
40,000	104.2	106.4	111	115.5	120.3
41,000	105.4	107.6	112.3	117	121.7
42,000	106.7	108.8	113.6	118.2	123.1
43,000	107.8	110.0	114.8	119.7	124.5
44,000	109.1	111.2	116.2	121.1	125.9
45,000	110.2	112.4	117.4	122.4	127.3
46,000	111.5	113.6	118.7	123.7	128.6

WARNING

Retract flaps as fast as acceleration will permit but no less than the setting given above any airspeed-gross weight combination. Serious loss of altitude may result. e.g., at 34,000 pounds when airspeed has increased to 103 knots, flaps should be retracted to 12°.

WARNING

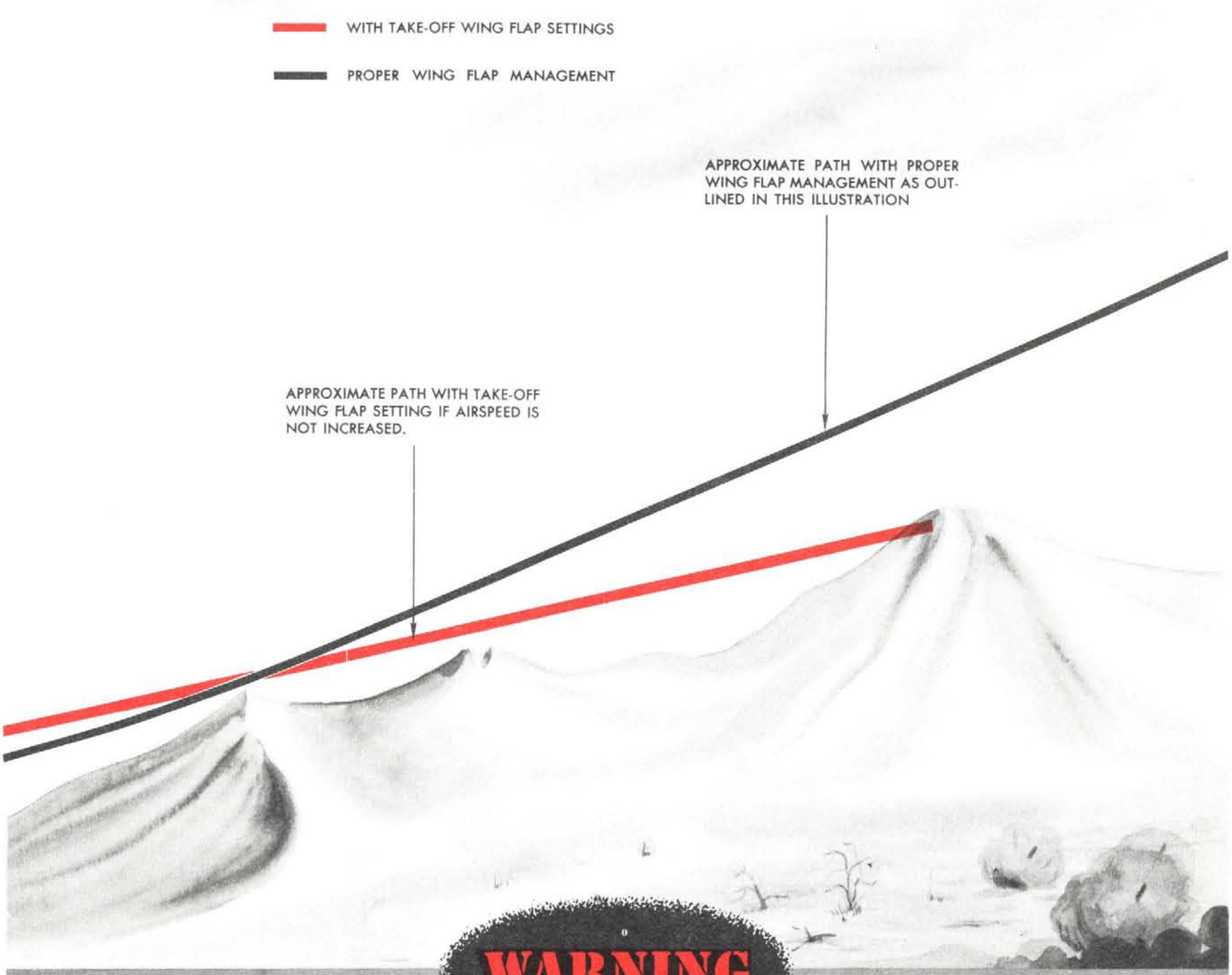
WITH ONE PROPELLER WINDMILLING, DO NOT ALLOW AIRSPEED TO FALL BELOW MINIMUM CONTROL SPEEDS SHOWN IN FIGURE 3-2.



During this phase, maximum angle of climb will be obtained with take-off flap setting. **Do not retract the flaps.**

Figure 3-4

CLIMB-OUT PROCEDURE


🟥 WITH TAKE-OFF WING FLAP SETTINGS
⬛ PROPER WING FLAP MANAGEMENT
APPROXIMATE PATH WITH PROPER WING FLAP MANAGEMENT AS OUTLINED IN THIS ILLUSTRATION
APPROXIMATE PATH WITH TAKE-OFF WING FLAP SETTING IF AIRSPEED IS NOT INCREASED.

WARNING

- If you fail to reduce rate of climb in order to increase airspeed, you will lose altitude when you retract the wing flaps.
- Retract the wing flaps as fast as acceleration permits.

24059-2

⑨ Cabin pressurization switch – As required. (CP)
If the left engine has failed the cabin pressurization switch may be turned to ALT AIR FLOW to reduce the load on the right engine. Alert crew to use oxygen as required.

Note

If it is necessary to continue flight on a single engine, maintain balanced fuel weight in the wings by operating engine alternately from the opposite wing tank. Refer to FUEL CROSSFEED OPERATION, Section VII, and the Appendix.

RESTARTING ENGINE IN FLIGHT

CAUTION

Do not attempt to restart engine unless it can be determined that it is safe to do so. It is safer to make a single-engine landing than to take a chance on starting an engine fire in flight.

1. Airspeed – 130 KIAS. (P)
   To prevent overspeeding in event of propeller malfunction the recommended airspeed for unfeathering is 130 KIAS.
2. Mixture control lever – IDLE CUTOFF. (CP)
3. Throttle – CLOSE. (CP)
4. Propeller speed control lever – DECREASE RPM (low light). (CP)
5. Engine fluid-off handle – Push in. (CP)
6. Main fuel shutoff valve switch – ON. (FM)

⑦ Manual feathering button – Pull to OUT until propeller rotation begins, then release. (P-CP)

WARNING

Watch the propeller during unfeathering and release the button when rotation begins. With this procedure the governor can control the propeller and pitch hunting or inadvertent reversal can be avoided if the propeller electrical system is faulty.

CAUTION

- If an engine has been shut down from five minutes to an hour, use starter to crank propeller through eight blades prior to unfeathering for hydraulic lock check. If an engine has been shut down for an hour or more, crank through 15 blades to insure adequate engine pre-oiling.
- Do not use the tachometer for determining when to return the button to NORMAL. The tachometer indication is too slow and holding the manual feather button to OUT longer than necessary when unfeathering may cause inadvertent pitch reversal if the circuit is inoperative or defective.
- If three attempts to unfeather a propeller are not successful, the pitch changing mechanism may be considered to be defective and further attempts to unfeather may ultimately lead to more serious trouble. Leave the propeller feathered and land as soon as practicable.

8. Engine speed – Stabilize at 1200 rpm. (CP)
9. Oil pressure – Checked. (P-CP)
10. Ignition switch – BOTH. (FM)
11. Mixture control lever – AUTO RICH. (CP)

Note

When climatic conditions are favorable to carburetor icing and the engine will not start with the mixture control placed in the AUTO RICH position, carburetor icing may be suspected. Place the carburetor heat control lever in the HOT position and hold the prime switch to the ON position. The engine should start and generate enough heat to warm the carburetor and clear it of ice.

12. Engine instruments – Within limits. (ALL)
13. Nacelle flaps, both engines – As required. (FM)
    Adjust nacelle flaps as required to keep cylinder head temperatures within limits.
14. Generator switch for shutdown engine–ON. (FM)
15. Alternator switch – As required. (FM)
16. Manual heat anti-ice shutoff handle – ON. (FM)
17. Load monitor switch – NORMAL. (FM)
18. Electrical equipment – As required. (ALL)

FUEL PRESSURE DROP — ENGINE OPERATING NORMALLY

Fuel pressure that drops below minimum operating limits while the engine continues to operate normally, constitutes an operational emergency due to the potential fire hazard of leaking fuel – the most likely cause of the pressure drop in this circumstance. Continued operation under these conditions could result in an avoidable engine fire. Do not retard the throttle for the affected engine if there is an indicated fuel pressure drop below minimum operating limits when an engine is operating normally. Retarding the throttle can result in an engine fire. Do not turn on fuel booster pumps if these conditions exist, as this will only increase the danger of fire. If the fuel pressure drops below minimum operating limits while the engine continues to operate normally, proceed as indicated under one of the following applicable paragraphs.

FUEL PRESSURE DROP DURING GROUND OPERATION — ENGINE OPERATING NORMALLY

If the fuel pressure drops below minimum operating limits, but the engine continues to operate normally above idle speed while taxiing or taking off, stop the airplane. Alert the tower and proceed as follows:

① **MIXTURE CONTROL LEVER — IDLE CUT OFF.** (CP)

2. **ENGINE FLUID-OFF HANDLE — PULL OUT.** (CP)
3. **FUEL SHUTOFF VALVE SWITCH — OFF.** (FM)
4. **FUEL BOOST PUMP SWITCH — OFF.** (FM)
5. **CABIN HEAT AND VENT SWITCH — SHUT OFF.** (CP)
6. **FIRE EXTINGUISHER SWITCH — ON (IF FIRE EXISTS).** (CP)
7. Ignition switch for shutdown engine – OFF. (FM)
8. Shut down other engine. (CP)

WARNING

- To prevent causing a possible ignition spark from electrical equipment, do not turn other electrical switches on or off until the defective fuel system has been found to be free of fuel leaks. It is important to leave the battery switch at ON in order to have direct current to discharge the engine fire extinguisher agent if required.
- Request the ground crew to stand by with fire fighting equipment until the danger of fire has been eliminated.

FUEL PRESSURE DROP DURING FLIGHT — ENGINE OPERATING NORMALLY

The fuel pressure-low warning light serves both engines. If the light illuminates, check the fuel pressure gages to determine which engine is affected. If the fuel pressure drops below the operating limits during flight, but the engine continues to operate normally, the cause may be one or more of the following: primer leakage, oil dilution solenoid leakage, engine-driven fuel pump bypass valve leakage, clogged pressure line, instrument failure, or line leakage. Whenever fuel pressure drops and the engine continues operating normally, the first concern of the crew must be to guard against the outbreak of an engine fire. The greatest danger lies in the fact that the crew develops a false sense of security because no fire exists at the time the fuel pressure drop is noticed or after several hours of flight. However, when the throttle is retarded (as in preparation for a landing), an engine fire develops and the results are usually disastrous. What has happened is that a fuel leak existed, but the cooling and dispersing effect of the airflow through the engine nacelle at cruising speed has prevented the start of a fire. When the throttle was retarded, the airspeed dropped and the airflow was reduced sufficiently to permit ignition of the leaking fuel. Any change in the airflow pattern, such as feathering the propeller or entering a climb, can start a fire if a fuel leak exists. Increasing the power is less likely to start a fire since airspeed will be increased, but even here there is a possibility of fire since the exhaust heat and flame pattern may change sufficiently to outweigh the increase in cooling airflow. Accordingly, it must be the objective of the crew to eliminate the fuel before any change is made to the airflow or exhaust pattern. The most effective way of accomplishing this is by moving the mixture control to IDLE CUT OFF before any throttle reduction, propeller feathering, or any other engine shutdown procedure is initiated. An additional advantage of moving the mixture control to IDLE CUT OFF is that it provides the most rapid means of eliminating exhaust stack flames and reducing exhaust heat. Possible courses of action, depending on the cause of the pressure drop are listed below:

SHUT DOWN THE ENGINE IMMEDIATELY.
Do this if the power is not necessary to sustain flight or to reach a safe destination.

Engine Shutdown

① **MIXTURE CONTROL LEVER — IDLE CUT OFF (BEFORE CHANGING AIRSPEED OR ALTITUDE).** (CP)

WARNING

Do not change airplane altitude or airspeed prior to mixture cutoff.

2. **PROPELLER FEATHERING BUTTON — PUSH TO FEATHER.** (CP)

Note

While propeller is feathering accomplish power, gear, and flap changes as necessary. Complete the following shutdown actions accurately and promptly.

3. **ENGINE FLUID-OFF HANDLE — PULL OUT.** (CP)

Note

If the handle cannot be pulled out, it can be turned to free the fire extinguisher switch and guard.

4. **MAIN FUEL SHUTOFF VALVE SWITCH — OFF.** (FM)
5. **FUEL BOOSTER PUMP SWITCH — OFF.** (FM)
6. **NACELLE FLAPS SWITCH — CLOSED.** (FM)
7. **MANUAL HEAT ANTI-ICE HANDLE — OFF.** (FM)
8. **FIRE EXTINGUISHER SWITCH — ON (IF FIRE EXISTS).** (CP)

WARNING

Discharge the fire extinguisher as soon as the engine stops or obviously will not slow down further.

Note

The fire extinguisher selector switch must be at the MAIN or RESERVE position in order to arm the fire extinguisher switches.

Clean Up Airplane

1. Generator switch (shutdown engine) — OFF. (FM)
② Electrical load — At minimum. (FM)
③ Load monitor switch — As required. (FM)
4. Alternator switch (shutdown engine) — OFF. (CP)
⑤ Alternator selector switch — As required. (CP)
6. Throttle (shutdown engine) — CLOSE. (CP)
7. Nacelle flap for operating engine — As required. (FM)
8. Ignition switch (shutdown engine) — OFF. (FM)
⑨ Cabin pressurization switch — As required. (CP) If the left engine has failed, the cabin pressurization switch may be turned to ALT AIR FLOW to reduce the load on the right engine. Alert crew to use oxygen as required.

Note

If it is necessary to continue flight on a single engine, maintain balanced fuel weight in the wings by operating engine alternately from the opposite wing tank. Refer to FUEL CROSSFEED OPERATION, Section VII and the Appendix.

KEEP THE AFFECTED ENGINE IN OPERATION AT OR ABOVE CRUISING SPEED WHILE MAINTAINING WATCH FOR FIRE.

Do this if it cannot be determined whether or not an actual leak exists and the engine is needed to either sustain flight or to maintain the required altitude for arrival at a safe destination. However, prior to power reduction for entry into the landing pattern, shut down the affected engine completely (by means of the mixture control — not by retarding the throttle) and accomplish a single-engine landing, unless the added power is absolutely essential to effect a safe landing.

CONTINUE OPERATING THE ENGINE NORMALLY.

This may be done if it can be unquestionably determined that the indicated fuel pressure drop has not resulted from a fuel leak.

Note

All other factors being equal, shutting down the engine immediately is generally the best course. However, action to be taken depends entirely upon the circumstances existing at the time. Such factors as the known condition of the airplane and the remaining engine, stage and requirements of the mission, and power requirements of the airplane should all be considered.

OIL PRESSURE DROP (OIL INGESTION)

Oil ingestion can be detected when high oil temperature occurs with subsequent drop in oil pressure and rapid decrease of engine oil quantity. If oil ingestion is experienced, the following action is recommended:

ⓐ Immediately reduce power on the affected engine. (CP)

b. Open the oil cooler doors to the fully open position. (FM)

c. Assume a level attitude to increase speed and thus increase the airflow over the engine and through the oil cooler area. (P)

ⓓ Retract or keep landing gear retracted unless preparing for landing. In the event that oil ingestion cannot be controlled, the propeller should be feathered and a single-engine landing made. (CP)

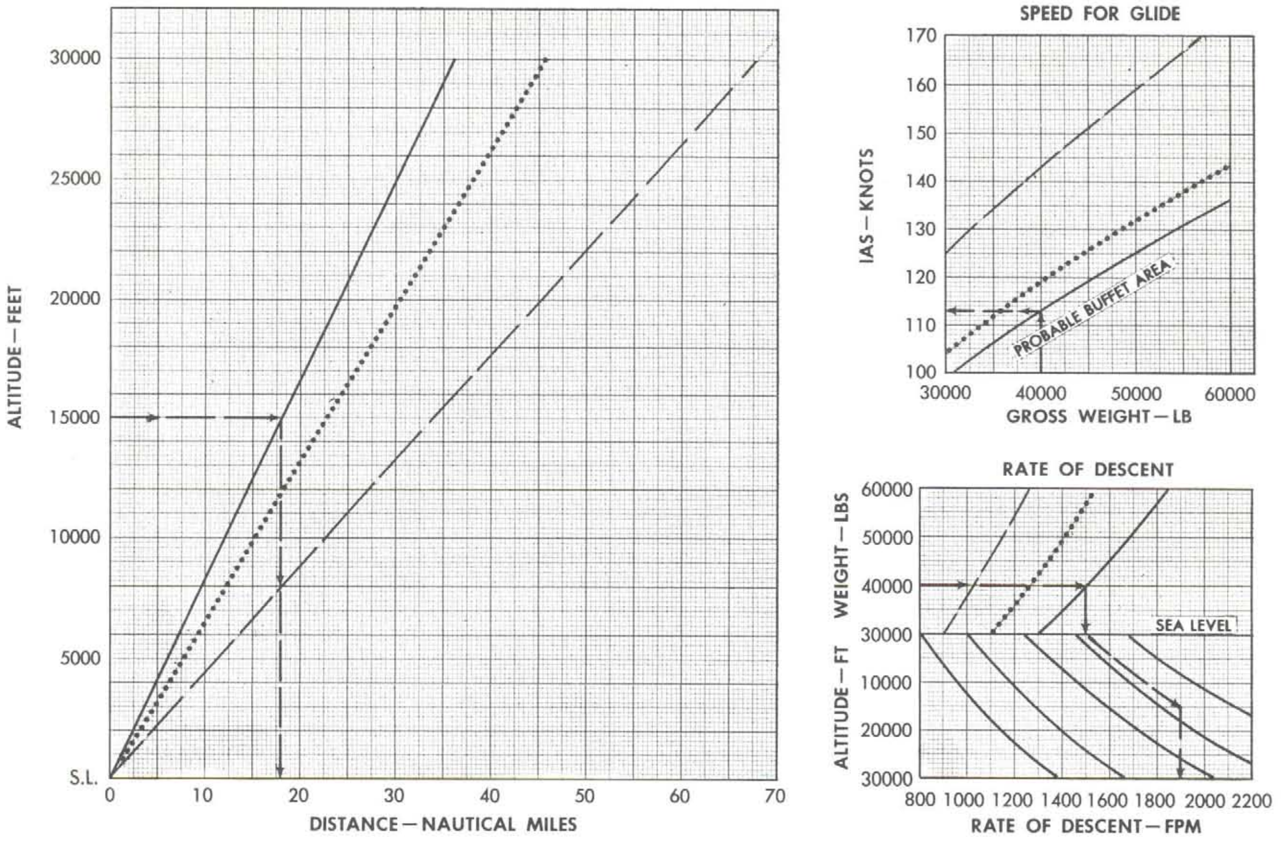
MAXIMUM GLIDE

See figure 3-5.

DRIFT DOWN

If an engine fails during flight at altitudes above single-engine ceiling, the airplane will drift down; i.e., lose altitude at a decreasing rate until stabilized flight is attained at the absolute ceiling for the power and instantaneous weight conditions. For best results operate the remaining engine at METO power (2600 rpm) and fly

MAXIMUM GLIDE



EXAMPLE:
GIVEN—
Gross Weight = 40,000 Pounds
Altitude = 15,000 Feet
Propellers Windmilling

FIND—
Speed for Glide = 113 Knots IAS
Rate of Descent = 1900 Feet per Min
Distance Travelled = 18 Nautical Miles

——— PROPELLERS WINDMILLING
•••••••• ONE PROPELLER FEATHERED
— — BOTH PROPELLERS FEATHERED

CONDITIONS:
FLAPS AND GEAR UP

EXTENDING THE GEAR REDUCES THE DISTANCE 20% TO 30% AND INCREASES THE RATE OF DESCENT 15% TO 20%

24060

Figure 3-5

the airplane at speeds for best climb. In cases of emergency at lower altitudes, use of military power (2800 rpm) for a limited time will reduce the altitude loss. Refer to DRIFT DOWN in the Appendix.

LANDING WITH ONE ENGINE INOPERATIVE

Single-engine landings are not much more difficult than those with both engines operating and are accomplished in much the same manner. Increase rpm to 2600. Delay gear and flap extension until after turning onto the final approach leg. Inasmuch as the landing gear locks down in less than 13 seconds, no special difficulty will normally arise during gear extension. Maintain safe altitude until the runway is definitely within gliding distance; then extend wing flaps as desired. Reduce power, allowing only sufficient time for possible slight retrimming before main wheel touchdown. See figure 3-6 for typical procedure.

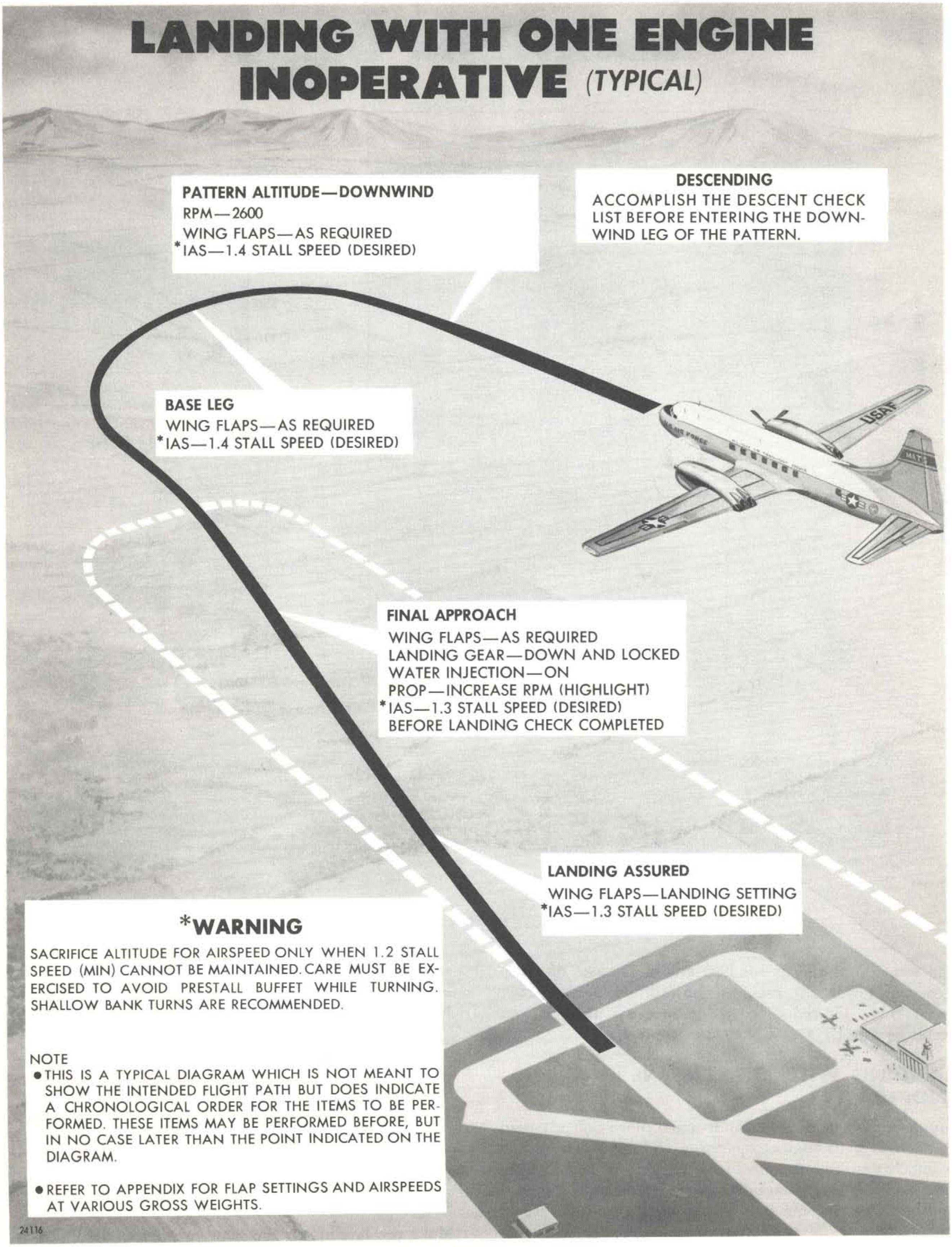
Note

> When landing gear is extended, place the propeller speed control lever in the INCREASE RPM position (high light).

LANDING WITH BOTH ENGINES INOPERATIVE

Make the landing in the same manner as described previously for landing with one engine inoperative except that the approach pattern must be varied in accordance

LANDING WITH ONE ENGINE INOPERATIVE *(TYPICAL)*



PATTERN ALTITUDE—DOWNWIND

RPM—2600
WING FLAPS—AS REQUIRED
*IAS—1.4 STALL SPEED (DESIRED)

DESCENDING

ACCOMPLISH THE DESCENT CHECK LIST BEFORE ENTERING THE DOWNWIND LEG OF THE PATTERN.

BASE LEG

WING FLAPS—AS REQUIRED
*IAS—1.4 STALL SPEED (DESIRED)

FINAL APPROACH

WING FLAPS—AS REQUIRED
LANDING GEAR—DOWN AND LOCKED
WATER INJECTION—ON
PROP—INCREASE RPM (HIGHLIGHT)
*IAS—1.3 STALL SPEED (DESIRED)
BEFORE LANDING CHECK COMPLETED

LANDING ASSURED

WING FLAPS—LANDING SETTING
*IAS—1.3 STALL SPEED (DESIRED)

***WARNING**

SACRIFICE ALTITUDE FOR AIRSPEED ONLY WHEN 1.2 STALL SPEED (MIN) CANNOT BE MAINTAINED. CARE MUST BE EXERCISED TO AVOID PRESTALL BUFFET WHILE TURNING. SHALLOW BANK TURNS ARE RECOMMENDED.

NOTE

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED. THESE ITEMS MAY BE PERFORMED BEFORE, BUT IN NO CASE LATER THAN THE POINT INDICATED ON THE DIAGRAM.
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.

Figure 3-6

with the reduced glide angle. Use brakes rather lightly near the beginning of the landing roll. This procedure will lessen the tendency to blow out tires.

GO-AROUND WITH ONE ENGINE INOPERATIVE

If a go-around is necessary during a single-engine approach, proceed in accordance with figure 3-7.

PRACTICE MANEUVERS WITH ONE ENGINE INOPERATIVE

In order to become thoroughly acquainted with the single-engine characteristics of the airplane, the following most important maneuvers should be practiced:

WARNING

- Practice these maneuvers at sufficient altitude so that in case of a stall, recovery can be made with an ample margin of safety.
- Observe correct procedure for restarting an engine in flight.

a. Engine failure at critical engine failure speed and takeoff speed.
b. Minimum control speed with one engine windmilling.
c. Best rate of climb for various flap settings.
d. Low speed turns with single engine.
e. Single-engine go-around.
f. Approach to stalls.

PRACTICE GROUND MANEUVERS

Practice bringing the airplane to a stop by using reverse pitch and brakes when an engine failure is experienced before critical engine failure speed is reached. During this maneuver it is important that the steering wheel be used by the pilot to keep the airplane on the runway. To get maximum braking effect, retract wing flaps to put more load on the landing gear, thus increasing tire friction with the runway.

PRACTICE OF ENGINE FAILURE AT CRITICAL ENGINE FAILURE SPEED AND TAKEOFF SPEED

It is recommended that a propeller not be feathered during single-engine takeoff practice, but that zero thrust on one engine be obtained by running the "dead" engine propeller speed lever to INCREASE RPM and applying power with the throttle to maintain engine rpm that corresponds with airspeed according to the following values:

KIAS	ENGINE RPM					
	SL	2000 Ft.	4000 Ft.	6000 Ft.	8000 Ft.	10,000 Ft.
100	1720	1770	1820	1880	1930	1980
110	1910	1955	2015	2075	2130	2190
120	2070	2140	2200	2270	2330	2400
130	2250	2320	2390	2460	2530	2600
140	2420	2500	2580			

Note

For prolonged operation (above traffic pattern altitude) under simulated single engine conditions, maintain 1700 rpm and 17 inches Hg manifold pressure on the idle engine.

It is recommended that the effects of trying to take off before takeoff speed is attained be demonstrated in flight at a safe altitude by showing the difference in rates of climb for speeds above and below takeoff speed with corresponding wing flap settings.

PRACTICE OF MINIMUM CONTROL SPEED WITH ONE ENGINE WINDMILLING

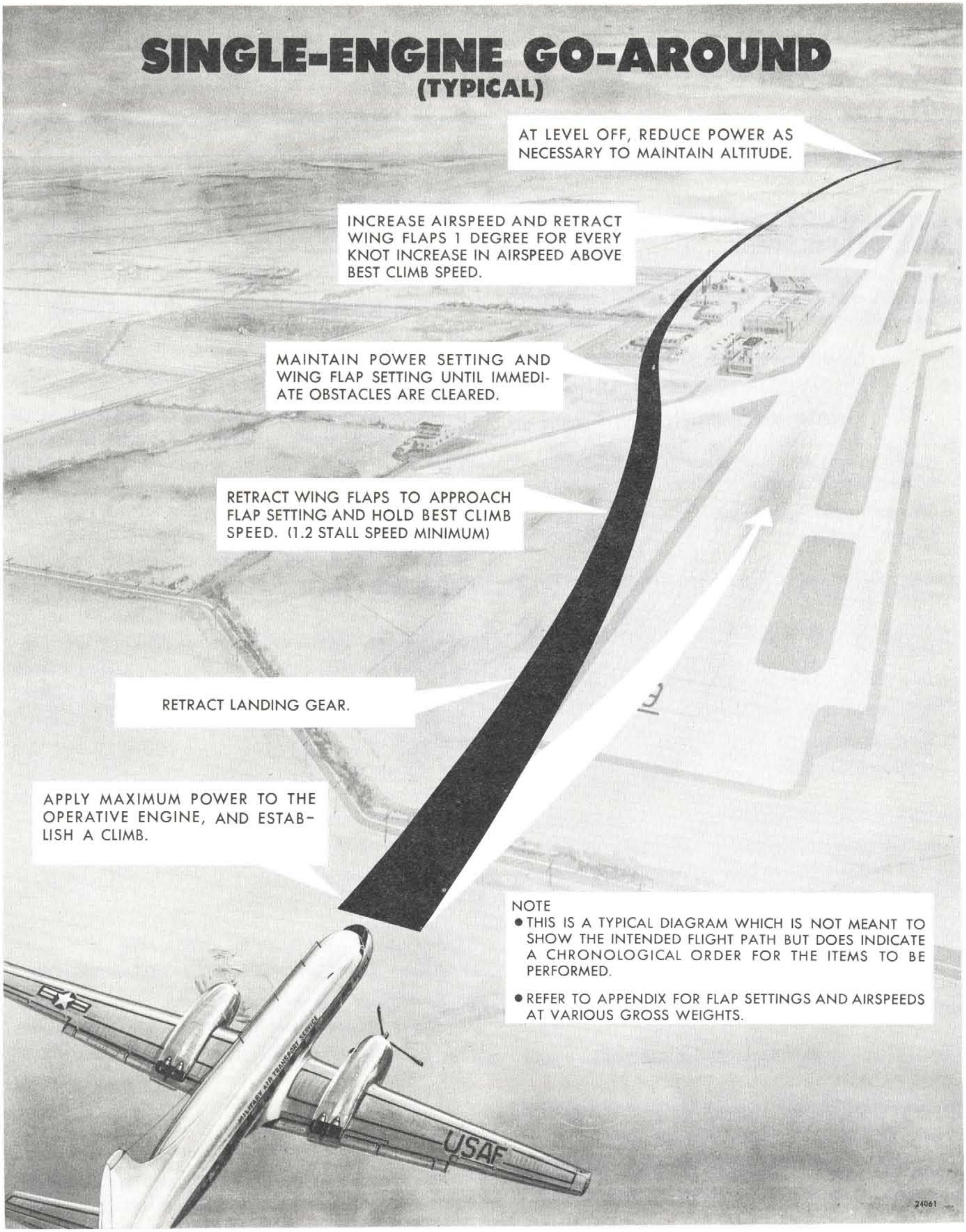
Minimum control speed can be demonstrated at any safe altitude. With one engine windmilling, the corresponding throttle closed, and the other engine operating at takeoff power, the airplane should be slowed down gradually until it is no longer possible to maintain flight in a straight line. It is important to note here that the airplane must be banked about 2° or 3° with the dead engine high. If this is not done, full rudder will be required at a much higher minimum speed. Excessive rudder causes a forward side slip with excessive drag, which materially affects the rate of climb. See figure 3-2 for Minimum Control Speeds.

PRACTICE OF BEST RATE OF CLIMB FOR VARIOUS FLAP SETTINGS WITH SINGLE ENGINE

It is extremely important that the pilot understand wing flap management. The best way to acquire this knowledge is by actually demonstrating the effect of speed on rate of climb with various wing flap settings. This can be done at any safe altitude with one engine feathered. First practice rate of climb with the best speed (1.2 stall speed) corresponding to the wing flap setting being used and then note rate of climb above and below this optimum speed. Also note loss of altitude when wing flaps are retracted before reaching the next higher speed for the next reduced wing flap setting.

SINGLE-ENGINE GO-AROUND

(TYPICAL)



AT LEVEL OFF, REDUCE POWER AS NECESSARY TO MAINTAIN ALTITUDE.

INCREASE AIRSPEED AND RETRACT WING FLAPS 1 DEGREE FOR EVERY KNOT INCREASE IN AIRSPEED ABOVE BEST CLIMB SPEED.

MAINTAIN POWER SETTING AND WING FLAP SETTING UNTIL IMMEDIATE OBSTACLES ARE CLEARED.

RETRACT WING FLAPS TO APPROACH FLAP SETTING AND HOLD BEST CLIMB SPEED. (1.2 STALL SPEED MINIMUM)

RETRACT LANDING GEAR.

APPLY MAXIMUM POWER TO THE OPERATIVE ENGINE, AND ESTABLISH A CLIMB.

NOTE

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED.
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.

Figure 3-7

PRACTICE OF LOW-SPEED TURNS WITH SINGLE ENGINE

CAUTION

Practice this maneuver at sufficient altitude so that in case of a stall, recovery can be made with an ample margin of safety.

The airplane is completely controllable in turns in either direction with one engine inoperative. Turns can be made up to 60° of bank with the dead engine on the down side, and with any selected power on the operative engine. While in a steep turn, with the inoperative engine on the down side, the airplane can be slowed down by climbing in the turn until the buffet warning occurs. The turn can be continued with perfect control even while this buffet continues.

PRACTICE OF SINGLE-ENGINE GO-AROUND

CAUTION

Practice this maneuver at sufficient altitude so that in case of a stall, recovery can be made with an ample margin of safety.

In practicing single-engine go-around, it is recommended that one engine be windmilled to simulate a feathered engine and that power be applied to maintain engine rpm in accordance with the airspeed-rpm values given in PRACTICE OF ENGINE FAILURE AT CRITICAL ENGINE FAILURE SPEED AND TAKEOFF SPEED. For procedure, see figure 3-7.

PRACTICE OF APPROACH TO STALLS ON SINGLE ENGINE

Stalls can be practiced at a safe altitude with one engine feathered and one engine operating at maximum continuous power. The stall should be approached with reduction in airspeed of approximately one knot per second. A buffet warning will be experienced in each case before the stall is encountered. This buffet warning will occur at about 13 knots above stall speed with the airplane clean, and four to five knots above stall speed with full flaps. In some cases with the airplane light, a minimum control speed will be encountered before the actual stall. In this case, the airplane will start to turn and may roll during the stall. The roll, however, will be controllable if the control column is brought forward and corrective action taken as soon as the roll starts. Do not hold back on the wheel after roll occurs. In most cases the airplane will normally stall and pitch straight away. See figure 6-1 for stall speeds.

PROPELLER FAILURE

PROPELLER BLADE FAILURE

During flight, the damage or loss of a propeller blade would make immediate identification extremely difficult due to severe vibration. Immediate power reduction on both engines (throttles to the CLOSE position and propeller speed control levers in the DECREASE RPM position until the low lights illuminate) may dampen vibration sufficiently to enable identification and feathering of the affected engine.

WARNING

Corrective action must be taken immediately to prevent engine separation.

OVERSPEEDING PROPELLER

An overspeeding propeller is one which has exceeded 2800 rpm, but is controllable by the propeller speed control lever.

RUNAWAY PROPELLER

If the propeller cannot be controlled by the propeller speed control lever it is considered to be a runaway propeller. Proceed as follows:

a. **RETARD THROTTLE.** (P)

b. **MAINTAIN BEST CLIMB SPEED FOR CONFIGURATION.** (P)

c. **PROPELLER FEATHERING BUTTON — PUSH TO FEATHER (IF REQUIRED).** (CP)

Note

Intermittent use of feathering button may be required to hold engine rpm within limits if single-engine climb performance will not clear obstacles or terrain.

If this condition exists, proceed as follows:

a. Push the manual feathering button to IN; then pull it to the NORMAL (half out) position as rpm drops within limits. (FM)

WARNING

Holding the feathering button all the way out may cause inadvertent propeller reversal, if the blade switch is defective or inoperative.

(b.) After reaching a safe altitude, retard the throttle to a point which will give 2800 rpm. Feather propeller unless it is essential for continued flight. (FM)

CAUTION

If propeller is not feathered maintain watch on oil quantity. If oil quantity decreases rapidly, feather the propeller.

c. Land as soon as possible.

FAILURE TO FEATHER

a. If the manual feathering button will not remain in, hold it in until feathering is completed. (CP)

b. If circuit breaker continues to pop out, hold in the circuit breaker until feathering is completed. The feathering pump circuit breaker is a non-trip-free breaker that may be held in the reset position in the event of an emergency. (FM)

c. If propeller still fails to feather, reduce airspeed to that for the best climb speed corresponding to the wing flap setting being used until obstructions are cleared. (P)

WARNING

Operating the engine fluid-off handle shuts off the supply of fuel, oil, and hydraulic fluid to the affected engine. If the propeller fails to feather and it can be definitely determined that a fire or fire hazard does not exist, leave the fluid-off handle in. This may prevent damage to the engine which could result from windmilling without lubrication.

d. Use the propeller speed control lever to place the propeller in full DECREASE RPM (low light). At this setting, windmilling drag will be at a minimum although considerably greater than when feathered. (CP)

POWER LOSS OR OSCILLATION

Note

Propeller oscillation may occur at high power settings at altitudes above 20,000 feet due to oil foaming and poor oil scavenging.

CAUTION

If engine overspeeding occurs, land at the nearest base. Note all conditions of overspeeding on Form 781.

Serious damage to the engine may result from overspeeding if power is restored suddenly while the propeller is in low pitch. If a momentary power loss or an appreciable oscillation occurs, proceed as follows:

a. Close throttle and reduce airspeed to approximately 130 KIAS. (P)

b. Mixture control lever – AUTO RICH. (CP)

c. Propeller speed control lever – DECREASE RPM. (CP)

d. If oscillation has resulted from fuel exhaustion, reestablish fuel pressure by proper setting of the fuel system controls. Refer to FUEL SYSTEM, Section VII. (FM)

e. Check for normal operation at reduced power. Apply power slowly, noting whether the condition recurs. (CP)

CAUTION

If power oscillation cannot be controlled by this procedure, feather the propeller and shut down the engine.

PROPELLER PITCH HUNTING

On Takeoff

If rpm oscillation is encountered during takeoff, return to the field immediately and determine the cause.

During Cruise

If rpm cannot be stabilized and the engine is running smoothly, the propeller pitch oscillation may be due to a sticky propeller governor. To overcome this condition, exercise the propeller speed lever from high rpm to low rpm several times. If this procedure does not correct the condition, land the airplane at the first opportunity and investigate the cause.

INADVERTENT PROPELLER REVERSAL

Results of controlled flight tests with one propeller in reverse pitch indicate that control of the airplane can be maintained if corrective action is taken immediately. It cannot be accurately predicted, however, what effects would be encountered should a propeller suddenly and unexpectedly go into reverse pitch at cruising speeds and power settings. Controllability of the airplane is expected to be most critical at low airspeed and high power settings. The propeller noise resulting from overspeed as the blade angle passes through flat pitch is unmistakable. The higher the airspeed, the higher the noise level. Deceleration of the airplane and possible yaw, buffeting, or backing effect would be pronounced at higher airspeeds. Closing the throttle of the affected engine will cause the engine to stall out and the propeller to start windmilling backward. This will be indicated by a zero indication on the tachometer. The amount of control then required will be approximately the same as that required for a normal windmilling propeller condition. If a suspected propeller reversal occurs, the following procedure may be used:

ⓐ **THROTTLE — CLOSE.** (CP)

Note

If altitude permits, close both throttles to reduce airspeed and minimize yaw. Immediately restore power to the engine which continues to indicate rpm.

b. **PROPELLER REVERSE CIRCUIT BREAKER — PULL OUT.** (FM)

ⓒ **PROPELLER FEATHERING BUTTON — PUSH TO FEATHER.** (CP)

WARNING

Under no circumstances should the engine be restarted. Do not reset the propeller reverse control circuit breaker after a propeller reversal in flight, as reversal may recur.

Note

If propeller will not feather out of reverse pitch, continued windmilling backwards will cause oil starvation and probable engine seizure.

FIRE

ENGINE FIRE ON THE GROUND

If an engine fire develops during the starting procedure, open the throttle and continue cranking to start the engine and blow the fire out. If the engine will not start and ground crew signals to cut the engine, or if airplane is moving, proceed with the following steps: (If taxiing or taking off, stop the airplane and alert the tower.)

① **MIXTURE CONTROL LEVER — IDLE CUT OFF.** (CP)

2. **ENGINE FLUID-OFF HANDLE — PULL OUT.** (CP)
3. **FUEL SHUTOFF VALVE SWITCH — OFF.** (FM)
4. **FUEL BOOSTER PUMP SWITCH — OFF.** (FM)
5. **CABIN HEAT AND VENT SWITCH — SHUT OFF.** (CP)
6. **FIRE EXTINGUISHER SWITCH — ON (IF FIRE EXISTS).** (CP)
   If the ground crew is not equipped with adequate fire fighting equipment, operate the fire extinguisher switch.

WARNING

Prolonged exposure (five minutes or more) to high concentrations of dibromodifluoromethane (DB) or its decomposition products can cause pronounced eye and nose irritation and should be avoided. It is safer to use than previous fire extinguishing agents such as carbon tetrachloride or methylbromide. However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

7. Ignition switch — OFF. (FM)
8. Shut down the other engine. (CP)

CAUTION

- Do not start the engine until the cause of fire has been determined and corrected.
- If the fire extinguishing system has been operated, the fire extinguisher containers must be serviced and the affected discharge tubing and contaminated area must be purged before proceeding with engine starting.

If the engine is running when an engine fire develops, advance the throttle and attempt to blow the fire out. If the fire persists, use the procedure outlined in the preceding paragraph.

ENGINE FIRE DURING FLIGHT

Safety of personnel and the airplane requires the use of optimum fire control measures in combating an inflight engine fire. Elapsed time from engine fire detection to initiation of fire control actions must be kept to a minimum. Tests have demonstrated that fire extinguishing agents are at maximum effectiveness when the engine fluid pumps are not actuating as a result of propeller feathering. Accordingly, initiation of feathering action cannot be delayed upon detection of an engine fire. The procedure presented below is designed for maximum fire control effectiveness.

Engine Shutdown/Maintain Controlled Flight

Identify the malfunctioning engine by the fire warning lights and visual observation.

① **PROPELLER FEATHERING BUTTON — PUSH TO FEATHER.** (CP)

Note

While the propeller is feathering accomplish power, gear, and flap changes as necessary. Complete the following shutdown actions accurately and promptly:

2. **MIXTURE CONTROL LEVER — IDLE CUT OFF.** (CP)
3. **ENGINE FLUID-OFF HANDLE — PULL OUT.** (CP)

ENGINE SMOKE AND FLAME IDENTIFICATION

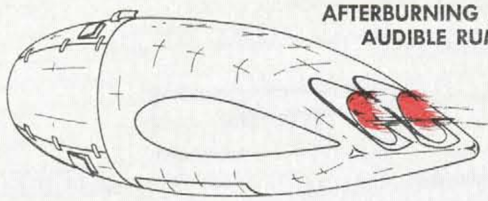
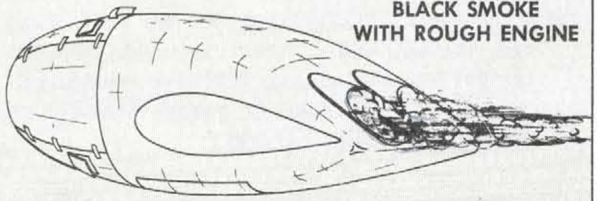
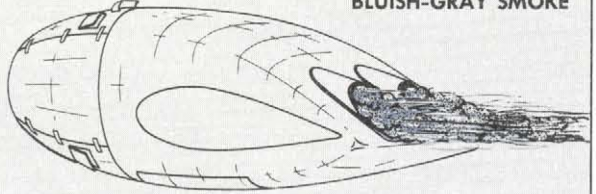
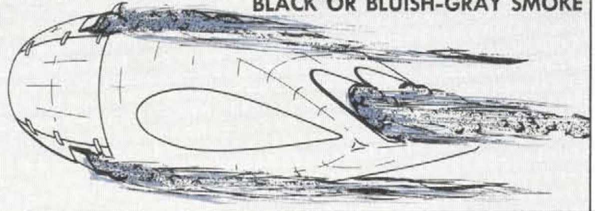
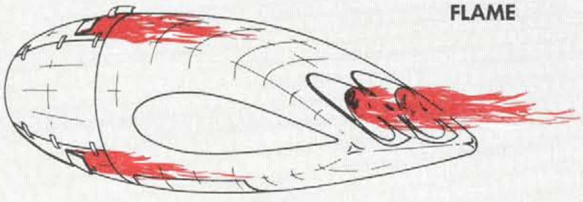
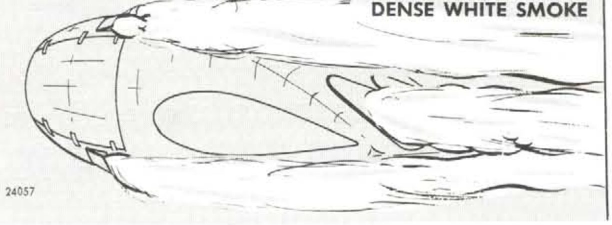
CONDITION	CAUSE	ACTION
AFTERBURNING AND/OR AUDIBLE RUMBLE 	1. Augmentor vanes closed. 2. Excessively rich mixture.	NOTE: Whenever flame or smoke trails from the augmentor tubes and augmentor position indicators indicate CLOSED place vane switches in TRAIL position. 1. Trail augmentor vanes. 2. Reduce power. Close nacelle flaps. Lean mixture.
BLACK SMOKE WITH ROUGH ENGINE 	Detonation, afterfire or backfire from rich mixture.	Reduce power.
BLACK SMOKE **(SAME ILLUSTRATION AS ABOVE)**	Possible oil leak.	Monitor oil pressure and quantity. If pressure drops below minimum—feather.
BLUISH-GRAY SMOKE 	Damaged or worn piston rings, permitting cylinder to pump oil.	No inflight action possible. Record on Form 781 and monitor condition.
BLACK OR BLUISH-GRAY SMOKE 	Oil fire.	Use fire and feather procedure.
FLAME 	Gasoline fire.	Use fire and feather procedure.
DENSE WHITE SMOKE  	Fire in induction system. Magnesium engine case has probably ignited.	Use fire and feather procedure. Alert crew for bail-out as fire can cause major structural damage.

Figure 3-8

Note

If the handle cannot be pulled out, it can be turned to free the fire extinguisher switch and guard.

4. **FUEL SHUTOFF VALVE SWITCH — OFF.** (FM)
5. **FUEL BOOSTER PUMP SWITCH — OFF.** (FM)
6. **NACELLE FLAPS SWITCH — CLOSED.** (FM)
7. **MANUAL HEAT ANTI-ICE HANDLE — OFF.** (FM)
8. **FIRE EXTINGUISHER SWITCH — ON (IF FIRE EXISTS).** (CP)

WARNING

Discharge the fire extinguisher as soon as the engine stops or obviously will not slow down further.

Note

The fire extinguisher selector switch must be at the MAIN or RESERVE position in order to arm the fire extinguisher switches.

Clean Up Airplane

1. Generator switch (shutdown engine) – OFF. (FM)
② Electrical load – At minimum. (FM)
③ Load monitor switch – As required. (FM)
4. Alternator switch (shutdown engine) – OFF. (CP)
⑤ Alternator selector switch – As required. (CP)
6. Throttle (shutdown engine) – CLOSE. (CP)
7. Nacelle flap for operating engine – As required. (FM)
8. Ignition switch (shutdown engine) – OFF. (FM)
⑨ Cabin pressurization switch – As required. (CP) If the left engine has failed, the cabin pressurization switch may be turned to ALT AIR FLOW to reduce the load on the right engine. Alert crew to use oxygen as required.

WARNING

Do not restart the engine. Attempt to restart will increase the danger of fire breaking out again.

FUESLAGE FIRE

WARNING

Fire in the fuselage must be fought with portable fire extinguishers. These extinguishers are filled with bromochloromethane (CB) pressurized with nitrogen to 150 psi. Prolonged exposure (five minutes or more) to high concentrations of CB or its decomposition products can cause pronounced eye and nose irritation and should be avoided. CB is an anesthetic agent of moderate intensity. It is safer to use than previous fire extinguishing agents such as carbon tetrachloride or methylbromide. However, especially in confined spaces, adequate respiratory and eye protection from excessive exposure, including the use of oxygen when available, should be sought as soon as the primary fire emergency will permit.

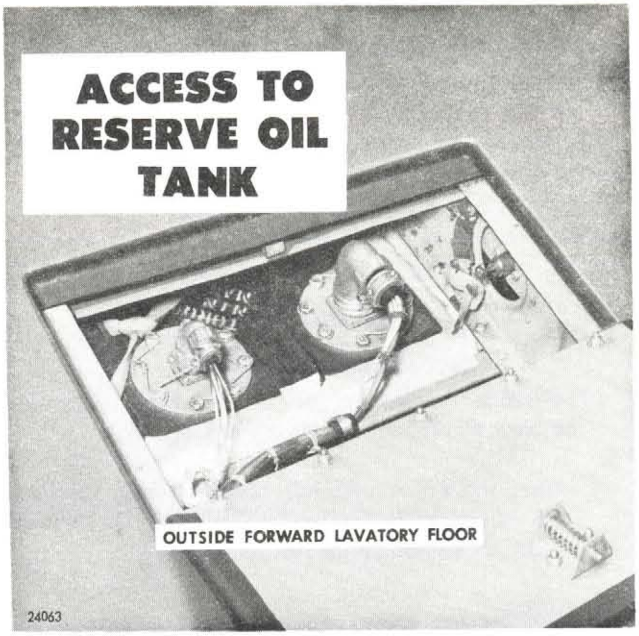


Figure 3-9

1. **ALERT THE CREW; ORDER USE OF OXYGEN (100%). DESIGNATE CREW MEMBER TO FIGHT FIRE.** (P)

Note

The users of the portable fire extinguishers will wear the portable oxygen units if the fire is not within reach of a fixed oxygen regulator.

② If cabin is pressurized, turn the cabin pressurization switch to the ALT AIR FLOW position. (CP)
3. If operating at an altitude requiring oxygen, descend to an altitude not requiring oxygen. (P)
4. Load monitor switch – OFF. (CP)
5. Cabin heat and vent switch – SHUTOFF. (CP)
6. Close any open windows. (P-CP)

Note

If the fire is below the floor, restrict the CB discharge to the below-floor area. An access door is provided in the floor outside the forward lavatory for fighting fire in the area of the reserve oil tank. For areas forward of that point, use the vent grills just above the floor along each side of the cabin to get access to discharge the CB. Kick out a section of the grill if necessary. Try to discharge the CB just forward of the fire, as circulation will carry the vapor aft.

WARNING

If the fire threatens to get out of control, warn the crew to prepare for emergency landing.

⑦ After the fire is definitely extinguished, ventilate the airplane. Refer to SMOKE AND FUMES ELIMINATION, this Section. (CP-FM)

WING FIRE

a. **ALERT CREW, ORDER USE OF OXYGEN (100%).** (P)

b. Turn off all electrical equipment of the affected wing. (ALL)

c. Sideslip the airplane away from the fire. (P)

d. If the fire is in the right wing, turn cabin pressurization switch to ALT AIR FLOW. (CP)

ELECTRICAL FIRES

Specific circumstances will, in most cases, dictate what action will be taken when the source and location of an electrical fire is known. The primary objective is to isolate the source of the fire. In case of an unidentified electrical fire proceed as follows:

1. **ALERT CREW; ORDER USE OF OXYGEN (100%). DESIGNATE CREW MEMBER TO DIRECT FIRE FIGHTING.** (P)
2. **METO RPM — SET.** (FM)

③ **CABIN PRESSURIZATION SWITCH — ALT AIR FLOW.** (CP)

④ **DC BUS SELECTOR SWITCH — EMERGENCY** (CP)

5. **INVERTER SELECTOR SWITCH — SPARE.** (CP)
6. **GENERATOR SWITCHES — OFF.** (FM)

Restoring Electrical Power

If exact source of fire has not been determined, restore electrical power only to essential items, and land as soon as possible.

1. Pull all circuit breakers and turn off all electrical equipment. (CP-FM)
2. Blower switches — LOW. (CP)
3. DC bus selector switch — NORMAL. (CP)
4. Generator switches (one at a time) — ON. (FM)
5. DC voltage and load — Checked. (FM)

⑥ Reset circuit breakers for essential equipment. (FM)

SMOKE AND FUMES ELIMINATION

To remove smoke or fumes from the fuselage when the cabin is pressurized, allow the cabin pressurization system to remain in operation. Smoke and fumes will be eliminated in approximately five minutes. If the cabin is not pressurized, open one of the direct vision windshields in the flight compartment, open doors between compartments, and remove one of the emergency exit hatches over the wing.

BAILOUT

WARNING

- The litter loading door should not be jettisoned in flight except in case of extreme emergency where all crew members are forced to abandon the airplane. There is a strong possibility that when the litter door is jettisoned it will strike and remove the stabilizer. Insure that everyone is in bailout position prior to jettisoning litter loading door.
- Do not attempt to open the main entrance door in flight under any circumstances. It is not structurally designed for opening in flight. Do not attempt to open any exits when the cabin is pressurized.

EMERGENCY DESCENT

The two recommended methods for emergency descent are low airspeed — maximum drag, and high airspeed — minimum drag. The low airspeed — maximum drag condition is recommended when structural damage to the airplane is suspected, when operating in turbulent air, or in case of engine fire, when the fire is contained within the engine or accessory cowling. The high airspeed — minimum drag condition is recommended if pressurization fails at high altitude.

Note

If an engine fire should become uncontrolled, with flames sweeping past the nacelle, the landing gear and wing flaps should not be lowered until just before landing. Airspeed limits should be strictly observed to avoid structural failure.

LOW AIRSPEED — MAXIMUM DRAG

a. Mixture control levers — AUTO RICH. (CP)

b. Close throttles and reduce airspeed to maximum full flap speed. (P)

c. Propeller speed control levers – INCREASE RPM. (CP)

ⓓ Lower landing gear and extend full flaps. (CP-FM)

The copilot will lower the landing gear and the flight mechanic will extend the flaps.

e. Descend at maximum full flaps airspeed. (P)

Note

With both propellers windmilling, rate of descent will be approximately 4700 to 5500 fpm. With one propeller feathered and one windmilling, rate of descent will be approximately 4400 to 5200 fpm.

HIGH AIRSPEED — LOW DRAG

a. Power as required. (P)

ⓑ Landing gear and flaps up. (CP-FM)

The copilot will raise the landing gear and the flight mechanic will retract the flaps.

c. Airspeed – 260 KIAS. (P)

Above 10,000 feet, reduce speed approximately six knots per 1000 feet.

WARNING

When operating at high airspeed, take into account atmospheric conditions and need for maneuvering the airplane. In no case exceed maximum dive speed. Do not exceed limiting airspeed with propeller feathered.

TAKEOFF AND LANDING EMERGENCIES (EXCEPT DITCHING)

TAKEOFF ABORTED

a. Hold airplane straight with left hand on steering wheel. (P)

Note

Nose wheel steering is normally effective with reverse thrust on one engine and the other engine inoperative. However, with full reverse power, brakes may be necessary to assist in maintaining directional control. The amount that nose wheel steering effectiveness is reduced is determined by the type of runway. Holding the control column forward will increase steering effectiveness.

WARNING

When operating on wet runways under single-engine conditions, the airplane has a tendency to veer in the direction of the good engine when reverse thrust is applied.

b. Throttles, both engines – REVERSE, as required. (P)

Note

Pull reverse propeller override indicator handle if red portion of shaft is not showing. The handles operate in unison. Pulling either handle operates both handles.

c. Brakes – As required. (P)

ⓓ Wing flaps switch – UP. (FM)

Note

The case may arise when brakes and reversed propellers will not stop the airplane on the remaining portion of the runway. Should ground conditions or obstruction beyond the end of the runway warrant it, retraction of the landing gear may be essential to prevent crew injury or more serious airplane damage. Refer to LANDING GEAR LEVER EMERGENCY OPERATION, this Section, for procedure to retract the landing gear before the airplane is airborne.

ENGINE FAILURE AFTER TAKEOFF (CONTINUED FLIGHT IMPOSSIBLE)

a. Reduce power on operative engine to maintain optimum directional control. (P)

b. Hold airplane straight with rudder. Lower nose, if possible, to maintain flying speed and directional control. Keep the wing on the dead engine side approximately 3° high. (P)

c. Retract or lower the landing gear as necessary, depending on terrain. The pilot must use his judgment in determining whether to extend or retract the landing gear. Keep in mind that landing gear may absorb a considerable amount of the initial shock. (CP)

d. Accomplish as much as possible of the procedure under ENGINE FAILURE DURING FLIGHT, this Section.

ⓔ Place both fuel shutoff valve switches in the OFF position before contact. (FM)

f. Land straight ahead, changing direction only as necessary to miss obstructions. Don't turn back to the field. (P)

CRASH LANDING

Before Approach

See figure 3-12 for individual crew duties. The following shall be accomplished prior to crash landing:

① **ALERT THE CREW AND PASSENGERS, BY ANNOUNCEMENT OVER THE PUBLIC ADDRESS SYSTEM.** (CP)

2. Cabin pressure – DUMP & ALT AIR FLOW. (CP)

3. Escape hatches – Open, and jettisoned. (Designated crew member)

4. Loose equipment – Secure or jettisoned. (Designated crew member)

5. Transmit distress signal, course, altitude, ground speeds, and position of landing. Turn IFF/SIF to EMERGENCY. (CP)

6. The flight mechanic shall occupy a seat in the cabin with safety belt fastened. (FM)

7. Order passenger seat belts fastened. (P)

8. Crossfeed – OFF. (P)

In order to avoid having fuel under pressure in the crossfeed line, have each tank feed its own engine, if possible.

⑨ Wing flap switch – As required. (CP)

⑩ Landing gear lever – As required. (CP)

Approach and Contact

① Landing gear lever – Down. (CP)

Note

Crash land with the landing gear extended if possible. If it is impossible to extend one of the main landing gears, land with the other gear extended. The extended gear, even on reasonably rough terrain, provides an absorption of the initial shock, resulting in less injury to personnel and damage to the airplane. If a foam-covered runway is available, a gear-up landing is recommended.

② Wing flap switch – As required. (CP)

3. Generator switches – OFF. (CP)

4. Warn the crew and passengers to brace for impact by announcement over public address system. (CP)

5. Maintain approach speed. (P)

6. Engine fluid-off handles–OUT, immediately before contact. (CP)

7. Main fuel shutoff valve switches – OFF. (P)

8. Ignition switches – OFF. (CP)

9. Battery switch – OFF on impact. (CP)

After Crash Landing

Hold crash landing positions until the airplane comes to rest. Exit from the airplane should be made in an orderly manner according to the routes shown in figure 3-11.

LANDING WITH LANDING GEAR RETRACTED

Prepared Surface

If it is impossible to extend one of the main landing gears, land with the other gear extended unless a foam-covered runway is available. If a foam-covered runway is available, a gear-up landing is recommended.

LANDING WITH NOSE GEAR RETRACTED — MAIN GEARS EXTENDED

If it is impossible to extend the nose gear, but the main gears can be extended, extend the main gears and make a landing in such a way as to bring the nose down on the runway before elevator control is lost. The airplane is sufficiently nose-heavy to cause extensive structural damage if the nose is allowed to remain high during the landing roll and is then allowed to come down suddenly as brakes are applied. Proceed as follows:

a. Alert the selected airfield. (CP)

b. Warn the crew and passengers to prepare for a crash landing. (CP)

c. Depressurize the cabin. (CP)

d. Jettison or secure all loose equipment. (Designated crew member)

e. Remove and stow escape hatches in the lavatory compartment or jettison. (Designated crew member)

f. Lock shoulder harnesses (If installed). (P-CP)

g. Make a normal approach and flare-out. (P)

h. Cut both engines on contact by moving the mixture control levers to IDLE CUT OFF. (CP)

i. Battery switch – OFF on contact. (CP)

j. Use the elevators to lower the nose gradually, but force the nose to make contact with runway before elevator control is lost. Keep the nose on the runway after it makes contact. Use the brakes lightly for steering and stopping. Heavy brake application will cause avoidable damage to the nose section and lessen the rudder steering effect. (P)

Note

The propeller blade tips will contact the runway when the nose is a little more than half lowered to the runway.

CAUTION

Extreme care should be exercised to avoid blowing a tire as a result of excessive brake application.

LANDING WITH FLAT TIRE

Maintain directional control by using nose wheel steering and reverse thrust. Use brakes as little as possible.

EMERGENCY ENTRANCE

Emergency entrance may be gained by opening the entrance door and litter loading door. The entrance door can be opened from the outside even though it is mechanically and electrically locked from inside. The litter loading door can be unlatched and lifted from outside. The escape hatches at each side of the cabin may be opened by pressing inward on a small plate located above each of the escape hatch windows. If these methods prove unsuccessful, the windows which have dotted yellow lines painted around them and the stenciling "CUT HERE FOR EMERGENCY RESCUE" may be cut out with an axe.

DITCHING

Note

No life rafts or stowage facilities are provided. If overwater flights are planned, suitable life rafts can be stowed in the aft cargo compartment.

Results of tests conducted with scale models indicate that the airplane is equal or superior in ditching safety potentials to other airplanes in the same general classification. The airplane has shown good static buoyancy qualities, floating slightly nose-down with all openings and important equipment remaining above the load water line. It is essential that crew members and passengers become thoroughly familiar with all procedures and their specific duties in the event of an emergency ditching. This may best be accomplished by performing ditching drills, prior to all overwater flights, in accordance with the Ditching Procedures, figure 3-12.

BEFORE DITCHING

If time and conditions permit, observe the major swell movements. Determine the direction of the major swell system by observing the sea from 2000 feet or above. At this altitude, the relatively regular parallel pattern of the predominant system stands out in clear relief. Note the compass heading from which the swell front approaches. Observe the surface conditions. Fly at an altitude under 1000 feet (preferably 200 or 300 feet) to observe surface conditions. Frequently the direction of the swell as observed from this lower altitude will vary considerably from the major system observed above 2000 feet.

Ditching Heading

Generally, the best ditch heading is parallel to the major swell regardless of wind direction. Under 20 knots, disregard the wind except to avoid downwind components when possible. (A formidable secondary swell system may necessitate a heading down swell and partially down wind.) Study successive likely headings and note the one in which the sea appears most favorable for a landing. Normally the heading that looks the smoothest will be the best.

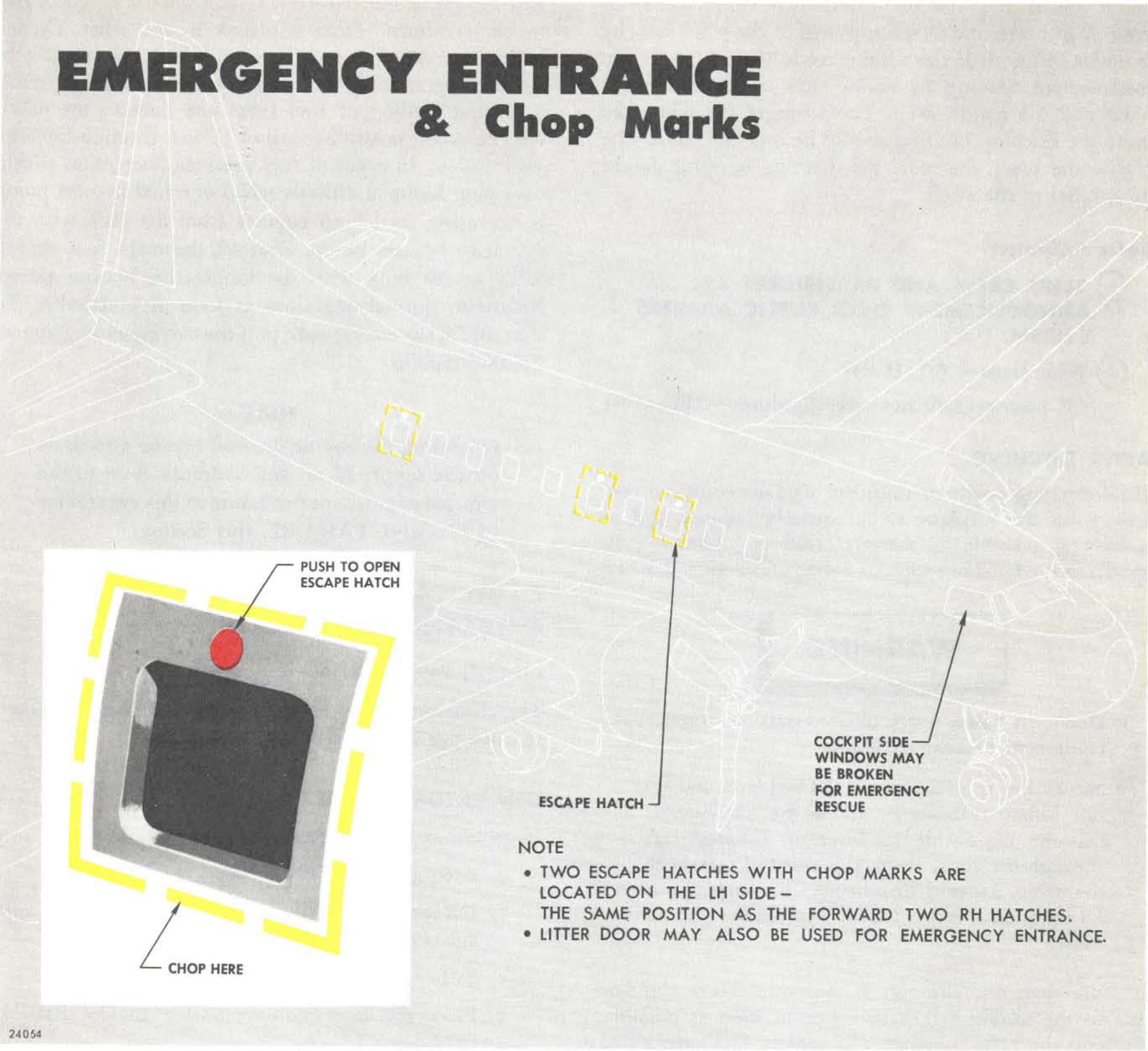
Touchdown Area

Look ahead for abnormally rough areas and try to avoid them. Look for a relatively smooth area when a minor swell fills in the trough of the major swell and flattens the resultant sea.

BEFORE APPROACH

① **ALERT THE CREW AND PASSENGERS TO PREPARE FOR DITCHING WITH AN ANNOUNCEMENT OVER THE PUBLIC ADDRESS SYSTEM.** (CP)

EMERGENCY ENTRANCE & Chop Marks


PUSH TO OPEN ESCAPE HATCH
CHOP HERE
ESCAPE HATCH
COCKPIT SIDE WINDOWS MAY BE BROKEN FOR EMERGENCY RESCUE
24054

NOTE

- TWO ESCAPE HATCHES WITH CHOP MARKS ARE LOCATED ON THE LH SIDE – THE SAME POSITION AS THE FORWARD TWO RH HATCHES.
- LITTER DOOR MAY ALSO BE USED FOR EMERGENCY ENTRANCE.

Figure 3-10

2. Depressurize cabin with manual dump valve. (CP)

   All personnel will remove cords, straps, parachute harness, and oxygen masks (below 12,000 feet). Shirt collars should be loosened and gloves put on if available. Put on life vests, but do not inflate.

③ Transmit distress signals, course, altitude, ground speed, and estimated position of ditching on emergency frequencies. Turn IFF/SIF to EMERGENCY. (CP)

④ Jettison hatches over wings and stow loose equipment. (Designated crew member)

5. Use as much of the fuel supply as possible before ditching in order to lighten the load and make flotation aids out of the fuel tanks. Do not completely exhaust the fuel supply, however, as a power-on landing is desirable. (P)
6. Crossfeed – OFF. (P)
   In order to avoid having fuel under pressure in the crossfeed line, have each tank feed its own engine, if possible.
7. Manual dump valve – NORMAL. (CP)

⑧ Wing flaps – As desired. (CP)

9. Landing gear lever – UP. (CP)

APPROACH AND CONTACT

Approach

Make a long low approach with nose-high attitude of approximately 9°. Head the airplane parallel to the major swells and aim the touchdown along the swell crest or just after the crest has passed, if the wind velocity is under 25 knots. If the wind exceeds 25 knots, select an intermediate heading by taking into consideration the wind and the major swell. The stronger the wind, the more the ditching heading should be into the wind. The higher the swell, the more the ditching heading should be parallel to the swell.

Before Contact

① **ALERT CREW AND PASSENGERS BY ANNOUNCEMENT OVER PUBLIC ADDRESS SYSTEM.** (CP)

② Wing flaps – 39°. (CP)

3. All electrical switches except ignition–OFF. (CP)

AFTER DITCHING

Hold ditching positions until the airplane comes to rest. Exit from the airplane in an orderly manner and as quickly as possible by the preferred or alternate exits shown in the Ditching Chart. (See figures 3-10 and 3-11.)

WARNING

- Don't, in haste, overlook necessary emergency equipment or assigned duties.
- Secure the raft-lanyard to the airplane and do not inflate raft until outside the airplane. It may be impossible to force an inflated raft through the door. To preclude loss of raft, keep the safety lanyard attached to the airplane at all times until raft is loaded and ready to be cut loose.

If more than one life raft is available secure the first raft to the second raft with a line as soon as possible. Keeping the rafts together will greatly facilitate search and rescue. Operate the emergency radio transmitter as soon as possible.

FUEL SYSTEM EMERGENCY OPERATON

If the fuel pressure drops or the fuel pressure-low warning light illuminates while the engine continues to operate normally, a fuel system emergency with associated fire hazard exists. For procedure in this event, refer to FUEL PRESSURE DROP – ENGINE OPERATING NORMALLY, this Section. During crossfeed operation, operate the fuel booster pump of the tank being used. Turn off the other fuel booster pump.

CAUTION

During all fuel system management operations, avoid creating fuel starvation in the system, and then suddenly supplying fuel.

The design of the crossfeed system does not permit fuel to be transferred from one tank to the other. During normal two-engine operation, crossfeed valves must be closed. Operation with crossfeed valves open might result in partial feeding of fuel from one tank to the other, with resultant possible overflow of fuel through the tank vent outlets. In event of fuel pressure fluctuation within operating limits at altitude when one fuel booster pump is operative, feed both engines from the tank with the operative booster pump. Shut off the main fuel shutoff valve at the tank with the inoperative booster pump. Return to normal operation as soon as practicable. To shut off fuel at the firewall, pull the corresponding engine fluid-off handle.

Note

Operating the engine fluid-off handle also shuts off the supply of oil and hydraulic fluid to the affected engine. For procedure in this event refer to ENGINE FAILURE, this Section.

ELECTRICAL POWER SUPPLY SYSTEM EMERGENCY OPERATION

CIRCUIT PROTECTION

The electrical system employs fuses and circuit breakers to open overloaded circuits automatically.

GENERATOR FAILURE

If generator failure occurs, proceed as follows:

a. Attempt reset. (FM)

b. Determine defective generator by checking voltage. (FM)

c. Turn off defective generator. (FM)

d. Place the load monitor switch to OVERRIDE. (FM)

CAUTION

When a generator failure occurs, it is imperative that the switch for the inoperative generator be immediately placed in the OFF position. The generator equalizer coils are connected through the generator switches, and leaving the switch in the ON position will cause voltage reduction of the operating generator.

If either generator fails and the load monitor switch is in the NORMAL position, the load monitoring circuit will automatically disconnect nonessential electrical and electronic equipment. Nonessential equipment items and their nonoperating indications, upon being automatically disconnected, are as follows:

ITEM	NONOPERATING INDICATION
Automatic approach equipment	Approach ready light will go out. Airplane will not follow ILS beam.
Automatic pilot system	Power switch will trip to OFF and the AUTO-PILOT OFF indicator light will illuminate.
Cockpit heater control	Will not control heater.
Instrument approach equipment (omnirange) and TACAN	Indicators will become inoperative and will not react to change in airplane positions. Aural signals will not be heard.
Marker beacon receiver	Marker indicator lights will not illuminate. Aural signals will not be heard.
Public address system	Will not function.
Radar altimeter	Indicator will not function.
Range receiver	Will not operate. Aural signals will not be heard.
UHF compass	Will not function.
Cabin white lights bright	Will not operate.
Attendant's utility light	Will not operate.
Passenger reading lights	Will not operate.
Galley light	Will not operate.
Lavatory lights	Will not operate.
Baggage compartment light	Will not operate.

When the load monitoring circuit has cut out all nonessential dc equipment, the use of certain nonessential equipment may still be desired. In this case, place the load monitor switch in OVERRIDE. This procedure actuates relays which permit nonessential dc equipment to draw power directly from the dc bus. All equipment which was operating before being automatically cut out will again receive power.

Note

> When operating in OVERRIDE position, do not overload the remaining generator. Use only such nonessential equipment as may be urgently required.

In the event of failure of both generators, place the dc bus selector switch in the EMERG position and the inverter switch in the SPARE position. This will provide dc power directly from the battery to operate the following:

a. Pilot's and copilot's turn-and-slip indicators.

b. Pilot's attitude indicator.

c. Spare inverter.

d. Pitot heat.

e. Instrument panel red lights.

f. Fire detection system and augmentor overheat warning bell.

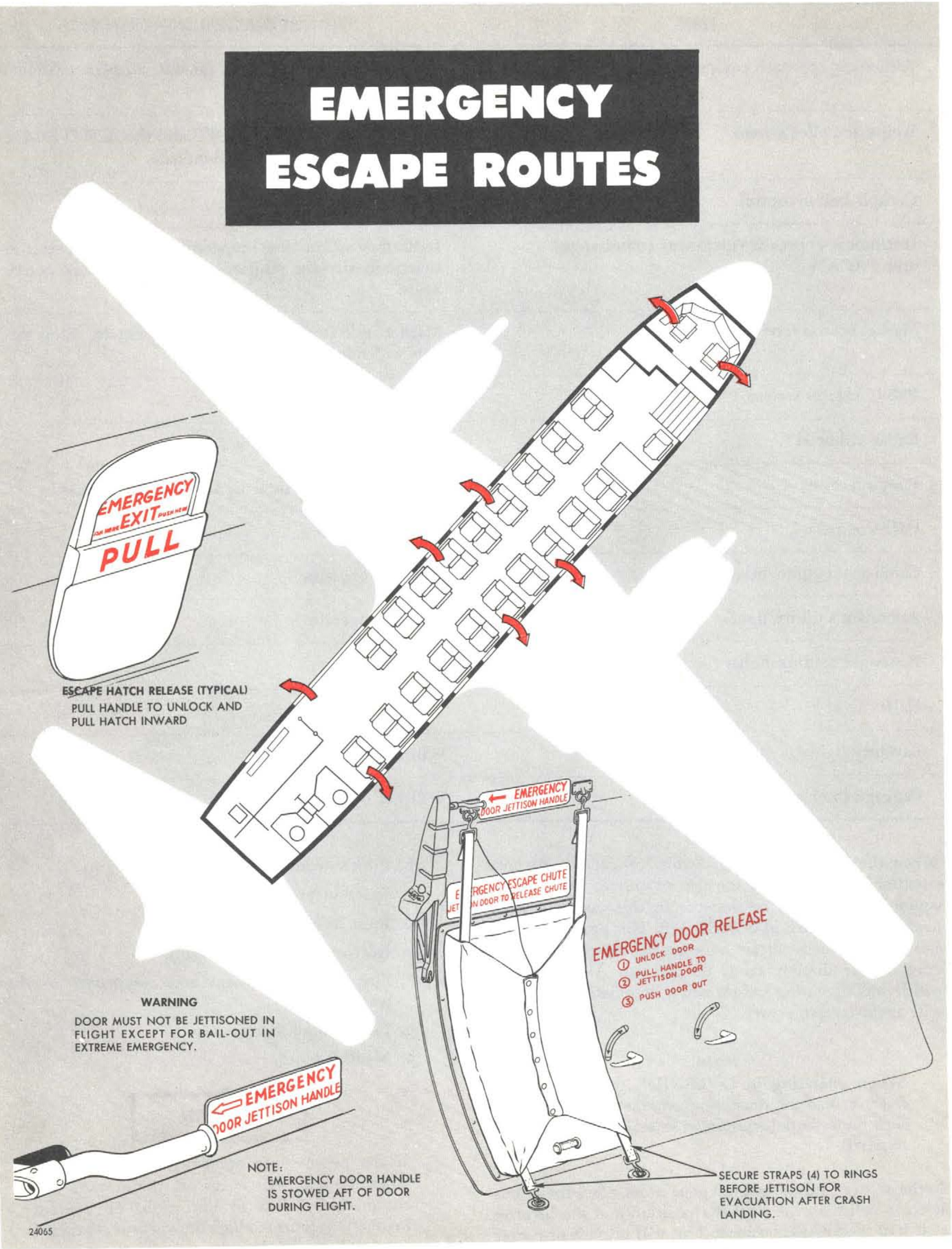
g. Fire extinguisher system.

h. Medical power.

CAUTION

If the engines are operating in high blower when the main bus is cut off, the blowers will automatically shift to low ratio. To prevent inadvertent return to high blower or if continued operation in high blower is not necessary, place blower switches in LOW position before restoring main dc power.

EMERGENCY ESCAPE ROUTES



ESCAPE HATCH RELEASE (TYPICAL)
PULL HANDLE TO UNLOCK AND PULL HATCH INWARD

EMERGENCY DOOR RELEASE
① UNLOCK DOOR
② PULL HANDLE TO JETTISON DOOR
③ PUSH DOOR OUT

WARNING
DOOR MUST NOT BE JETTISONED IN FLIGHT EXCEPT FOR BAIL-OUT IN EXTREME EMERGENCY.

NOTE:
EMERGENCY DOOR HANDLE IS STOWED AFT OF DOOR DURING FLIGHT.

SECURE STRAPS (4) TO RINGS BEFORE JETTISON FOR EVACUATION AFTER CRASH LANDING.

Figure 3-11

The spare inverter will in turn supply regulated ac power for the remaining flight instruments, engine instruments and radio, with the exception of the autopilot. If an iron lung patient is on board, manual pumping of the "lung" should be initiated as soon as possible to reduce the electrical load and prolong battery life. If dc radio equipment is required, remove all electrical load from main dc bus by pulling all circuit breakers on the circuit breaker panel behind the copilot and all circuit breakers except items of equipment desired on the radio rack circuit breaker panel. Then return battery switch to the NORMAL position.

WARNING

If both generators fail, land as soon as possible. Battery power will be rapidly exhausted, with consequent failure of all dc and regulated ac operated instruments, systems, and equipment.

INVERTER FAILURE

In the event the main inverter output fails, the corresponding warning light will illuminate and the inverter switch must be manually placed in the SPARE position. In this position the spare inverter assumes the main inverter load and the autopilot is disconnected. If the spare inverter also fails, the inverter warning light marked "SPARE OUT" will illuminate. The loss of both inverters will deprive the pilot of all electrically operated flight and engine instruments with the exception of the turn-and-bank indicator and engine temperature instruments.

ALTERNATOR FAILURE

If an alternator fails, the alternator selector switch, located on the pilots' pedestal, permits selection of function for the remaining alternator. If only No. 1 alternator is operating, the alternator selector switch in NORMAL will furnish power to bus No. 1 for propeller de-icing, windshield de-icing, alternator-generator scoop de-icing, oil heater power, glide-slope receiver, and the identification system. The selector switch in 2 OFF—1 ON BUS 2 will furnish power to bus No. 2 for the radar altimeter, cockpit heater and galley. If only the No. 2 alternator is operating, the selector switch in NORMAL will furnish power for the equipment supplied by bus No. 2. The selector switch in 1 OFF—2 ON BUS 1 will furnish power for bus No. 1.

ELECTRICAL FAILURE OF INSTRUMENT CIRCUIT

When a power failure occurs in the circuits of certain instruments, the indicators will freeze, maintaining the reading shown when power was interrupted, and may thus give a false indication. The instruments are:

Note

Vibration may cause indicators to move from frozen position.

Alternator-generator hydraulic pressure gage
Augmentor vane position indicators
Autopilot directional indicators
Engine and reserve oil tank quantity gages
Fuel flowmeters
Fuel pressure gages
Fuel quantity gages
Magnetic heading course indicators
Main hydraulic system pressure gages
Oil pressure gages
Radio compass indicators
Torquemeters

HYDRAULIC POWER SUPPLY SYSTEM EMERGENCY OPERATION

In the event of main hydraulic system failure, proceed as follows:

a. Hydraulic pressure bypass handle—BYPASS (UP). (FM)
b. Attempt to determine cause of system failure. (ALL)

EMERGENCY HYDRAULIC PUMP OPERATION

To operate the hydraulic system when the engine-driven pumps are not operating, proceed as follows:

a. Place the hydraulic pressure bypass handle in PRESS. (DWN).
b. Turn the emergency hydraulic pump switch to ON.
c. Operate the emergency hydraulic pump periodically so that hydraulic powered equipment can be operated normally.

CAUTION

Do not operate the emergency pump continuously for longer than five minutes. Allow the pump to cool for at least one-half hour after each five-minute period of continuous operation.

Note

Any interruption in the dc power supply system trips the emergency hydraulic pump circuit breaker. Therefore, if the pump fails to operate when its switch is turned on, check the pump circuit-breaker-tripped light (on main circuit breaker panel). If it is illuminated, press the circuit breaker switch below it to RESET position.

DITCHING PROCEDURES

FIRST ACTION

PILOT

1. Alert crew with "prepare for ditching" and give approximate time remaining, or "ditching imminent" if less than five minutes remain.
2. Advise Co-pilot and Flight Mechanic of intentions and release Flight Mechanic if he is no longer needed.
3. Remove necktie, loosen straps and oxygen mask below 12,000 ft. MSL. Loosen collar and remove eye glasses. Don life vest (do not inflate).
4. Remove all other loose objects from cockpit.
5. Tighten seat belt securely and adjust shoulder harness.

CO-PILOT

1. Assist Airplane Commander as ordered.
2. Depressurize airplane — below 12,000 ft.
3. Transmit "MAYDAY" on VHF if possible to nearest receiving station and relay message giving position, altitude, course, ground speed and intentions. IFF/ SIF emergency.
4. Remove necktie, loosen straps and oxygen mask below 12,000 ft. MSL. Loosen collar and remove eye glasses, don life vests (do not inflate), tighten seat belt securely and adjust shoulder harness.

FLIGHT MECHANIC

1. Assist pilots if possible and relay orders to rear of airplane.
2. When released by the Airplane Commander, tie down or secure all loose equipment, starting at extreme rear and ending at cockpit entrance. Secure cockpit door in open position. Fasten and secure baggage compartment gates.
3. Remove escape hatches over wing and jettison after receiving verbal report "all patients secured" from Medical Technician.
4. Return to cockpit and advise Airplane Commander of the status of the cabin, don life vest (do not inflate).

24066-1

Figure 3-12 (Sheet 1 of 4)

DITCHING IMMINENT	POSITION	AFTER CONTACT
5 MINUTES LEFT 1. Give order "ditching imminent." 2. Give last minute warning to crew "brace for impact." 3. Lock shoulder harness. 4. Turn off generators and place Load Monitor Switch to OVERRIDE.	Pilot's seat.	1. Pick up URC 4 radio and forward first aid kit and proceed to cabin and assume command. 2. Direct evacuation of airplane. 3. Leave airplane after assuring all personnel have been evacuated. 4. Board life raft, inflate life vest and assume command.
1. Move seat back. **ON APPROACH** 1. Wing flaps—full down. 2. Gear—up. **IMMEDIATELY BEFORE CONTACT** 1. All electrical power switches except ignition switches—off. 2. Lock shoulder harness.	Co-Pilot's seat.	1. Keep seat until airplane is completely stopped. 2. Follow Airplane Commander from cockpit, pick up fire ax, flare pistol and flares and URC-4 radio and proceed to cabin. 3. Remove water cans and box lunches, if needed, and stand by to put in life raft. 4. Assist Flight Mechanic to remove emergency radios and equipment. 5. Leave airplane, board life raft. Inflate life vest and take command of second life raft, if available.
1. Remove tie, eye glasses and sharp objects, loosen collar, fasten and adjust seat belt.	Extreme rear aisle seat of cabin.	1. Remain seated until airplane is firmly stopped. 2. Jettison litter door. 3. Remove life raft and Gibson Girl radio from rear of airplane, launch and inflate life raft. 4. Put Gibson Girl radio and emergency equipment in life raft. 5. Board life raft, inflate life vest and stand by to assist patients and other crew members.

24066-2

Figure 3-12 (Sheet 2 of 4)

	FIRST ACTION	DITCHING IMMINENT
FLIGHT NURSE	1. Advise patients to secure their seat belts and advise the Medical Technicians which patients are to be moved, don life vest and assist patients with life vests (do not inflate). 2. Assist the Medical Technicians in moving the patients. 3. Brief the patients on the following: (1) The nature of the trouble encountered. (2) Keep seats and remain calm, etc. (3) Do not leave seats until the aircraft is firmly stopped. (4) Order in which the patients will be evacuated. (5) Instruct patients to remove eye glasses, neckties, false teeth and loosen collar; women to remove high heeled shoes. 4. Secure medical equipment that will be needed after evacuation.	**5 MINUTES LEFT** 1. Check patients seat belts to see that they are tight. 2. Take ditching seat and fasten and adjust seat belt. 3. Remove tie, eye glasses and sharp objects, loosen collar.
NO. 1 MEDICAL TECHNICIAN	1. Determine movement of patients with the Flight Nurse. 2. Proceed to front of cabin and start moving patients, who are physically able, to seats. 3. Secure all other litter patients who remain on litters. 4. Don life vest (do not inflate). 5. Check litter door jettison handle in place. 6. Assist Flight Nurse to ready medical supplies for ditching.	1. Take designated seat and fasten seat belt. 2. Remove tie, eye glasses and sharp objects, loosen collar. Fasten and adjust seat belt.
NO. 2 MEDICAL TECHNICIAN	1. Determine patient movement with Flight Nurse. 2. Proceed to rear of cabin and move physically able patients to seats. 3. Make inspection and determine that litter straps and patients' seat belts are tight and seat backs erect. Report same to Flight Mechanic. 4. Assist the Flight Mechanic to tie down loose equipment and remove escape hatches. 5. Remove first aid kit from rear wall of aircraft and secure kit to pants belt. Don life vest (do not inflate).	1. Take designated seat and fasten and adjust seat belt. 2. Remove eye glasses and neckties. Check other crew members sitting around you to insure that they have done likewise.

24066-3

Figure 3-12 (Sheet 3 of 4)

POSITION	AFTER CONTACT
Aisle seat rear facing Flight Mechanic.	1. Remain seated until airplane is firmly stopped. 2. Assist patients to evacuate the airplane; ambulatory patients first, litter patients next and mental patients last. 3. Put necessary emergency equipment on board life raft. 4. Evacuate the airplane, board life raft and inflate life vest.
Rear window seat, extreme rear of cabin.	1. Keep seat until the airplane is firmly stopped. 2. Assist the Flight Nurse to evacuate patients. If the litter door is jammed, assist the patients to leave the airplane through the escape hatches located over the wing; otherwise, any escape hatch open. 3. Evacuate the airplane, board life raft and inflate life vest.
Forward aisle seat.	1. Keep seat until airplane is firmly stopped. 2. Assist the Flight Nurse to evacuate patients. If the litter door is jammed, assist the patients to leave the airplane through the escape hatches located over the wing; otherwise, use any open escape hatch. 3. Board life raft and inflate life vest.

NOTE

EQUIPMENT

THE EMERGENCY EQUIPMENT FOR OVERWATER FLIGHTS WILL VARY DEPENDING ON THE NATURE OF THE MISSION AND IT WILL BE THE PILOT'S RESPONSIBILITY TO THOROUGHLY BRIEF EACH CREW MEMBER ON HIS SPECIFIC DUTIES PRIOR TO DEPARTURE.

ESCAPE HATCHES

ONLY THOSE ESCAPE HATCHES LOCATED OVER THE WING, FORWARD SIDE HATCHES, WILL BE REMOVED PRIOR TO DITCHING. AFTER THE AIRPLANE HAS COME TO REST IN THE WATER AND THE WATER LEVEL AND WAVE ACTION CAN BE DETERMINED, THE REST OF THE ESCAPE HATCHES MAY BE REMOVED TO EVACUATE THE AIRPLANE.

ALL CREW MEMBERS AND PASSENGERS WILL EVACUATE THE AIRPLANE AFTER DITCHING THROUGH ONE OF THE FOLLOWING EXITS LISTED IN THE PREFERRED ORDER:

1. LITTER LOADING DOOR.
2. ESCAPE HATCHES OVER LEFT WING.
3. FLIGHT COMPARTMENT LEFT SIDE WINDOW.
4. ESCAPE HATCHES OVER RIGHT WING.
5. FLIGHT COMPARTMENT RIGHT SIDE WINDOW.

ADDITIONAL INSTRUCTIONS

1. FLIGHT MECHANICS AND MEDICAL TECHNICIANS WILL BE RESPONSIBLE FOR LAUNCHING THE LIFE RAFTS.
2. ALL CREW MEMBERS WILL BE RESPONSIBLE FOR ASSISTING PATIENTS OR PASSENGERS INTO THE AVAILABLE LIFE RAFTS IN AN ORDERLY MANNER.
3. CAUTION SHOULD BE TAKEN TO INSURE LIFE RAFT IS SECURE TO THE AIRPLANE WHILE BEING INFLATED AND DURING LOADING PROCESS.
4. RAFTS SHOULD REMAIN CLOSE ENOUGH TO AIRPLANE TO FACILITATE RESCUE BUT FAR ENOUGH AWAY TO AVOID CONTACT WITH GAS AND OIL AS THEY WILL DETERIORATE RAFTS.
5. WHEN MEDICAL CREW IS NOT CARRIED THE FLIGHT MECHANIC WILL PERFORM ALL NECESSARY DUTIES IN REAR OF AIRPLANE.

24056-4

Figure 3-12 (Sheet 4 of 4)

In the event of a main hydraulic system pressure line failure, the accumulator can be charged and the wing flaps, brakes, and litter loading door can be operated by placing the hydraulic pressure bypass handle in the BYPASS (UP) position and operating the emergency hydraulic pump. However, this procedure is limited by the amount of reserve fluid in the reservoir. The normal reserve of 1.3 gallons provides for one full wing flap cycle and 12 to 15 normal brake applications.

WING FLAPS EMERGENCY OPERATION

The wing flaps cannot be moved mechanically. To change the wing flap setting normally or in an emergency, hydraulic pressure is required. Normal pressure is supplied by the engine-driven pumps supplying the main hydraulic system. Emergency pressure is supplied as follows:

a. If engine pumps are inoperative and the accumulator is charged, control the wing flaps in the normal manner. Accumulator pressure will supply the flap motor for approximately one complete flap actuation cycle. The accumulator can be recharged by use of the emergency hydraulic pump.

b. In the event of main hydraulic system line failure, the reserve supply in the reservoir can be used to operate the wing flaps. Place the bypass handle in the BYPASS (UP) position, hold the emergency hydraulic pump switch to the ON position, and control the wing flaps in the normal manner.

c. In the event the wing flap switch circuit fails, the wing flap selector valve can be operated manually by means of the emergency handle on the valve. The valve is accessible through the hinged door located on the cabin floor (figure 3-13). Pull the handle for flaps down; push the handle for flaps up; hold the handle in either operating position until the desired flap setting is obtained.

LITTER LOADING DOOR EMERGENCY OPERATION

Hydraulic power for operation of the rear loading door is supplied by the flap hydraulic system. Emergency pressure can be obtained by following the procedure outlined under EMERGENCY PUMP OPERATION and WING FLAPS EMERGENCY OPERATION, this Section.

LANDING GEAR SYSTEM EMERGENCY OPERATION

In the event of failure of both engine-driven hydraulic pumps, the landing gear can be operated by use of the emergency hydraulic pump. Proceed as follows:

Ⓐ Hydraulic pressure bypass handle – PRESS (DWN). (FM)

Ⓑ Emergency hydraulic pump switch – ON. (FM)

Ⓒ Landing gear lever – UP or DOWN. (CP)

WARNING

Do not use the emergency pump for landing gear operation if it is evident that the failure of the main system is due to a ruptured line. The landing gear operation would result in further loss of fluid and thus create a fire hazard. Refer to EMERGENCY HYDRAULIC PUMP OPERATION, this Section.

LANDING GEAR EMERGENCY RELEASE OPERATION

The landing gear can be drop-lowered by gravity but cannot be retracted except by hydraulic pressure. The up-latches are provided with a mechanical linkage to the landing gear lever. Moving the lever to DOWN position releases the up-latches for gravity gear extension. Air load on the extended gear will actuate the down-latches. Opening the oil cooler doors will direct airflow against the wheels, aiding the gear for lock down.

CAUTION

The recommended speed for emergency lowering of the gear is 130 knots.

Note

Approximately 60 pounds pull must be exerted on the landing gear lever to release the up-latches if the hydraulic pressure bypass handle is in BYPASS (UP) position.

LANDING GEAR HANDLE JAMMED IN UP POSITION

If the landing gear handle becomes jammed in the UP position, the following procedure may be used to extend the landing gear:

a. Place the hydraulic pressure bypass handle in the BYPASS (UP) position. (FM)

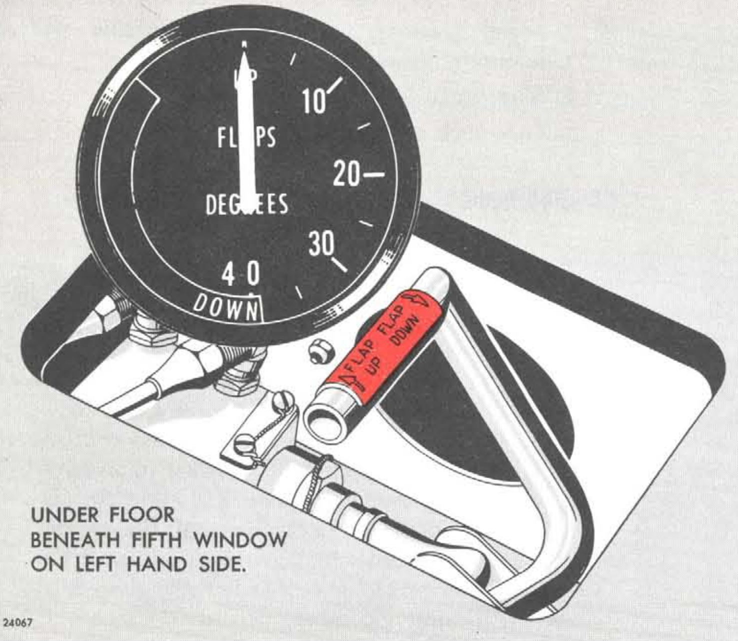
b. Break the safety wire on the emergency landing gear up-latch release knob and turn the knob to the RELEASE position momentarily and then return the knob to the OFF position. (P)

Note

This procedure may be used if the landing gear handle can be moved to the DOWN position but the connection to the landing gear selector valve is broken.

WARNING

Do not move the bypass handle to the PRESS (DWN) position or the landing gear will retract.



CAUTION

Since there is no electrical limit control in effect when the wing-flap control circuit is de-energized, operation of the emergency wing-flap handle requires constant reference to the wing-flap position indicator to avoid overrunning the UP or DOWN limit stops at the wing flaps. Forcing the wing-flap drive motor to continue to turn after the limit has been reached will severely stress the wing-flap drive mechanism until the motor stalls. If the wing-flap drive components are defective, such excessive torque stress might damage the wing-flap torque tube and cable installations.

Figure 3-13

EMERGENCY LANDING GEAR-UP LATCH RELEASE SYSTEM OPERATION

a. If the cable to the landing gear selector valve should fail, all three landing gears will remain in the UP position. When the landing gear control lever is placed in the DOWN position, use procedure outlined in LANDING GEAR HANDLE JAMMED IN UP POSITION.

b. Should one or two of the landing gears extend normally with the other(s) remaining in the UP position, proceed as follows:

    (1) Place the hydraulic bypass in the BYPASS (UP) position. (FM)

    (2) Break the safety wire on the emergency landing gear up-latch release knob, turn the knob to the RELEASE position momentarily and then return to the OFF position. (P)

    (3) Place the hydraulic pressure bypass handle in the pressure (DOWN) position. (FM)

Note

In the event the indicator for the nose gear does not indicate gear down and locked, and if visual inspection through the window in the floor aft of the pedestal shows that the down latch is not engaged, make a normal landing. The loads applied to the nose gear in landing are applied in a direction which locks the gear.

LANDING GEAR LEVER EMERGENCY OPERATION

An emergency release button, located on the copilot's side of the pedestal, is provided to allow emergency release of the landing gear lever from its DOWN position after take-off in the event the gear-actuated solenoid fails to release the landing gear lever latch automatically. The lever may then be moved out of the DOWN position by simultaneously pushing in on the emergency release button. This procedure can also be used to raise the landing gear, before the weight of the airplane is off the gear, during an aborted takeoff when ground conditions beyond the end of the runway would cause extensive damage to the airplane if the gear were left in extended position. Should the landing control lever jam, not permitting operation of the landing gear, remove the adjacent plate on the pedestal and pull down and hold the "mushroom" shaped locking collar which is found on the bottom of the control lever. The landing gear control lever may then be used to raise and lower the gear.

HYDRAULIC SYSTEM FAILURE — LANDING

If a hydraulic system failure is encountered, alert the airport control tower of the difficulty. Notify the tower that the gear cannot be retracted for a go-around after it has been lowered by free fall. Fly normal traffic pattern. The following procedures shall be used for landing:

1. **HYDRAULIC PRESSURE BYPASS HANDLE — BYPASS (UP).** (FM)

CAUTION

Keep the hydraulic pressure bypass handle in the BYPASS (UP) position until after landing and the landing gear safety pins have been installed.

2. Emergency hydraulic pump switch – ON (check pressure 2900 psi), then OFF. (FM)

   Build up accumulator pressure with the emergency hydraulic pump to 2900 psi. Then place the switch OFF and see if pressure remains up.

CAUTION

If accumulator pressure will not build up or if pressure does not remain at 2900 psi, a complete hydraulic failure is indicated. No attempt should be made to lower wing flaps. Whatever hydraulic pressure is available should be reserved for braking. During the early part of the landing roll, attempt to apply hydraulic brakes. While there is no assurance that hydraulic brakes will be available, even a slight amount of braking will greatly reduce tire wear and damage often associated with emergency air brake operation. (To conserve brake pressure, do not pump brakes.) If hydraulic braking is ineffective, the airplane may be stoped as described under EMERGENCY AIR BRAKE OPERATION, this Section.

3. Emergency hydraulic pump switch – ON, lower approach flaps, then OFF. (FM)
4. Landing gear – Free fall at 130 KIAS. (CP)
5. Emergency hydraulic pump switch – ON, lower landing flaps. (FM)

   When on final approach and landing is assured, lower landing flaps and leave the emergency hydraulic pump ON until completion of the landing.

CAUTION

- Since the nose wheel steering system will be inoperative, reversing, if used, should be accomplished with caution.
- The landing gear cannot be raised with the hydraulic pressure handle in the BYPASS (UP) position.
- The airplane should be stopped straight ahead. Shut down engines and install gear pins before having airplane towed from runway.

HYDRAULIC SYSTEM FAILURE — GROUND OPERATION

1. **HYDRAULIC PRESSURE BYPASS HANDLE — BYPASS (UP).** (FM)
2. **EMERGENCY HYDRAULIC PUMP SWITCH — ON.** (FM)
3. **BRAKES — AS REQUIRED.** (P)

   Bring the airplane to a complete stop because nose wheel steering will not be available without hydraulic pressure.
4. Shut down both engines. (CP)
5. Gear lock safety pins – Installed. (FM)

EMERGENCY AIR BRAKE OPERATION

CAUTION

- Extreme caution should be exercised in using reverse thrust on landing with loss of hydraulic brake pressure and/or hydraulic system pressure, due to the possible loss of nose wheel steering and subsequent loss of directional control. If only one propeller should reverse upon landing, close the engine throttles and allow the airplane to roll down the runway until the ground speed has reduced sufficiently to allow operation of the emergency air brakes without danger of wheel locking and subsequent tire damage.
- When reverse thrust is available from one or both engines, it must be used during the initial high-speed ground roll since the use of air brakes at that time may cause wheel locking and tire damage. The emergency air brake system should be reserved for final slowing and stopping of the airplane.

In case of hydraulic brake pressure failure, and if reverse propeller thrust is not available, use the emergency air brake knob on the pilot's console as follows:

a. Move the airbrake knob to the HOLD position. (P)

   There should be no braking action at this point.

b. For braking at high speed, cycle the air brake knob alternately from ON to OFF as rapidly as possible. If the knob is held to the ON position too long, it will cause the tires to skid, resulting in loss of braking action and damage to the tires. (P)

c. After the airplane has been slowed down by this method, it can be brought to a stop by moving the knob to the ON position and then back to the HOLD position after the desired braking action is felt. (P)

CAUTION

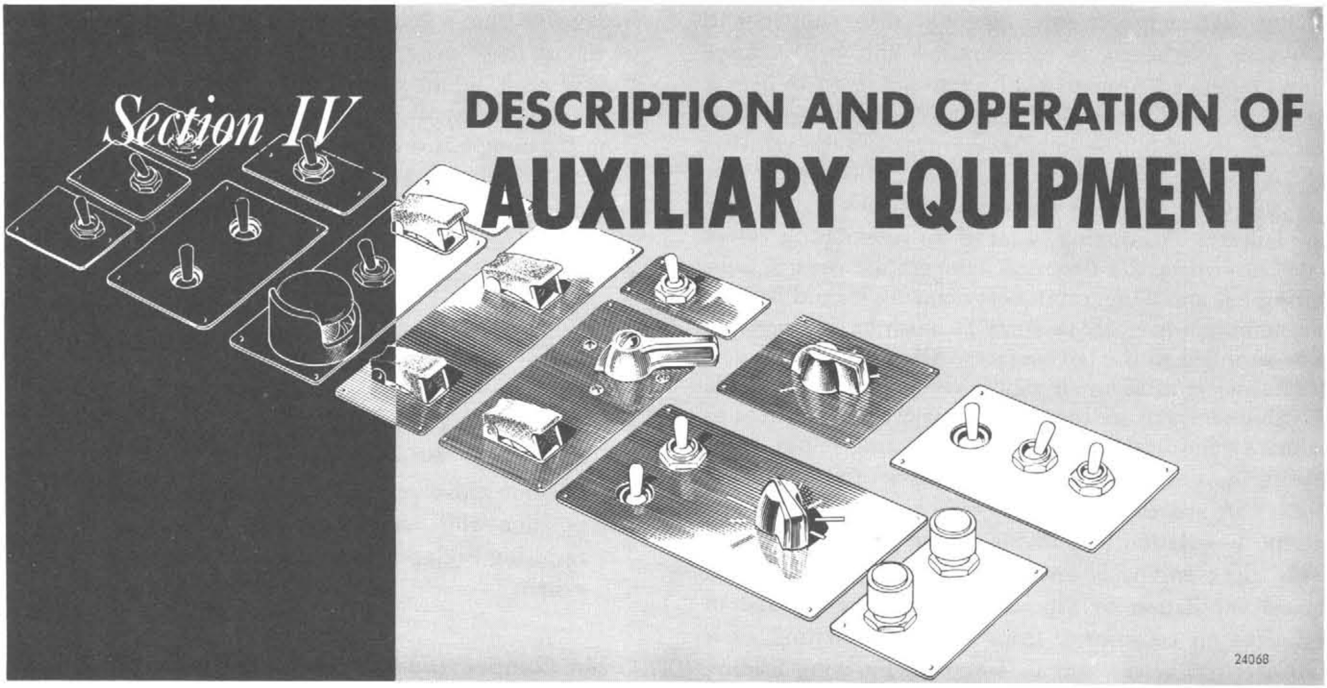
Bleed the hydraulic system at the earliest opportunity after using the emergency air braking system. Air left in the system lines would cause actuating failure in subsequent hydraulic operation.

Note

With the air bottle charged, eight brake applications can be made.

Section IV

DESCRIPTION AND OPERATION OF AUXILIARY EQUIPMENT



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AIR-CONDITIONING SYSTEM

The air-conditioning system (figures 4-4 and 4-5) provides fuselage ventilation, pressurization, and temperature control automatically during flight. All or part of the system, however, may be operated on a selective non-automatic basis, without pressurization, should such operation be required or preferred. Forced draft ventilation is provided by an air compressor driven by a hydraulic motor. A separate hydraulic system is provided for this purpose. The air compressor takes air from a scoop in the lower surface of the right wing and forces it through a heat exchanger and, if required, through a refrigeration unit and intercooler to ventilation outlets in the fuselage. The air vents overboard through regulator valves that restrict outflow to provide pressurization of the fuselage. The rate of airflow is constant at 65 pounds per minute, which is sufficient to change the air in the fuselage every five minutes and provide a maximum pressure differential of 3.5 psi. A cabin altimeter indicates the pressure and altitude differentials. An automatic relief valve and a manual dump valve are provided to assure cabin pressure relief during descent. Temperature control is effected automatically at any selected temperature within a range of 55° to 85°F. Cooling air is obtained from a ram scoop in the right wing leading edge. Heating air is obtained under ram pressure from heat collector muffs installed around the inboard augmentors in the nacelles. A heating air valve opens and closes at the heat exchanger. (These same heat valves and ducts serve the tail leading edges during anti-icing.) The heating and cooling air mix before entering the heat exchangers and then vent overboard. A refrigeration unit bypass valve allows regulated amounts of the ventilating air to bypass the refrigeration unit and intercooler. The refrigeration unit is powered by the compression force of the ventilating air and incorporates an expansion turbine which can cool the ventilating air substantially below outside air temperatures. Positioning of all of the modulating valves is determined by the electronic temperature control unit. During tail anti-icing, cabin heat demands should be kept to a minimum in order to allow as much heat as possible to be supplied to the tail surfaces. All of the heat generated in the ventilating air as it is compressed is available for cabin temperature control. This is usually sufficient to maintain comfortable temperature. Heating is not available during ground operation due to lack of ram pressure at the forward end of the augmentor heat muff in the nacelle. Ventilation is available during ground operation if the right engine is operating at 1400 rpm or more. Should ventilation by alternate air flow be selected in flight, the air compressor stops and all ventilating air is then obtained at the ram air scoops in the wing leading edges. The air from the right scoop then passes through the heat exchanger but bypasses the refrigeration unit and intercooler on its way to the ventilation outlets. The ram air from the left scoop goes directly to the cabin outlets, but if heating is demanded, this flow is restricted. The heat exchanger is furnished with heating and cooling air as before, but cooling below outside temperature is not possible in this method of operation because the air compressor, refrigeration unit, and intercooler are then inoperative.

CABIN COMPRESSOR HYDRAULIC SYSTEM

The air compressor of the air-conditioning system is operated by an integral hydraulic system (figure 4-1) separate from the main hydraulic power supply system. Two hydraulic pumps driven by the right engine supply normal operating pressure (3000 psi maximum) whenever the right engine is operating at 1400 rpm or more and the cabin pressurization switch is in AUTO position. These pumps provide fluid under pressure to the hydraulic motor that operates the air compressor. When the cabin pressurization switch is placed in ALT AIR FLOW position, a bypass valve in the pressure line opens and allows the fluid to flow freely from the pumps to the compressor sump, thus preventing fluid pressure buildup and leaving the air compressor inactive. A fluid temperature indicator and a hydraulic pressure-low warning light are provided on the copilot's instrument panel skirt.

Cabin Pressurization Switch

The guarded cabin pressurization switch (figure 4-2) has AUTO and ALT AIR FLOW positions. In AUTO position, the switch closes a dc circuit to the closing side of the bypass valve in the cabin pressure hydraulic system bypass line, thus forcing fluid to flow through the hydraulic motor that operates the air compressor. In ALT AIR FLOW position, the switch closes a dc circuit to the opening side of the bypass valve which lets fluid flow directly from the pumps at the right engine to the sump of the air compressor, thus bypassing the compressor motor. DC power is also connected at this time to the opening side of the refrigeration unit bypass valve, the alternate (ram) air shutoff valve, and the cabin pressure relief valve. This allows ventilation to proceed under ram pressure from the alternate air scoops in the wing leading edges.

CAUTION

Do not move pressurization switch to AUTO position while the right engine is running. The resulting high-pressure surge could damage the system.

Cabin Compressor Hydraulic Temperature Gage

A temperature gage (49, figure 1-7) is provided to indicate the temperature of hydraulic fluid in the return manifold of the cabin compressor hydraulic system. The gage is energized from the main dc bus through a temperature bulb installed in the return manifold. If any essential operating component or valve in the cabin compressor hydraulic system fails to function in a safe and efficient manner, temperature of the fluid will rise. If the temperature rises above the normal maximum limit, the system must be shut down until the defect is repaired.

Cabin Compressor Hydraulic Pressure-Low Warning Light

A pressure-low warning light (48, figure 1-7) will be on if the right engine is not running or in the event of fluid loss or system malfunction. If the light comes on when the right engine is running, the cabin compressor hydraulic system must be shut down to prevent cavitation of the pumps or damage to system components. The light is powered by the main dc bus.

Cabin Compressor Hydraulic Pressure Gage

This pressure gage (47, figure 1-7), on the copilot's instrument panel skirt, registers the hydraulic pressure at the air compressor motor. The gage is operated by 26-volt regulated ac power.

Cabin Compressor Fluid Sight Gage

A direct-reading glass tube hydraulic fluid sight gage is attached to the outboard side of the cabin compressor air compressor. It is placarded "Hot Fluid Max Level, Nor (normal), Min After Engine Run."

CABIN COMPRESSOR HYDRAULIC SYSTEM

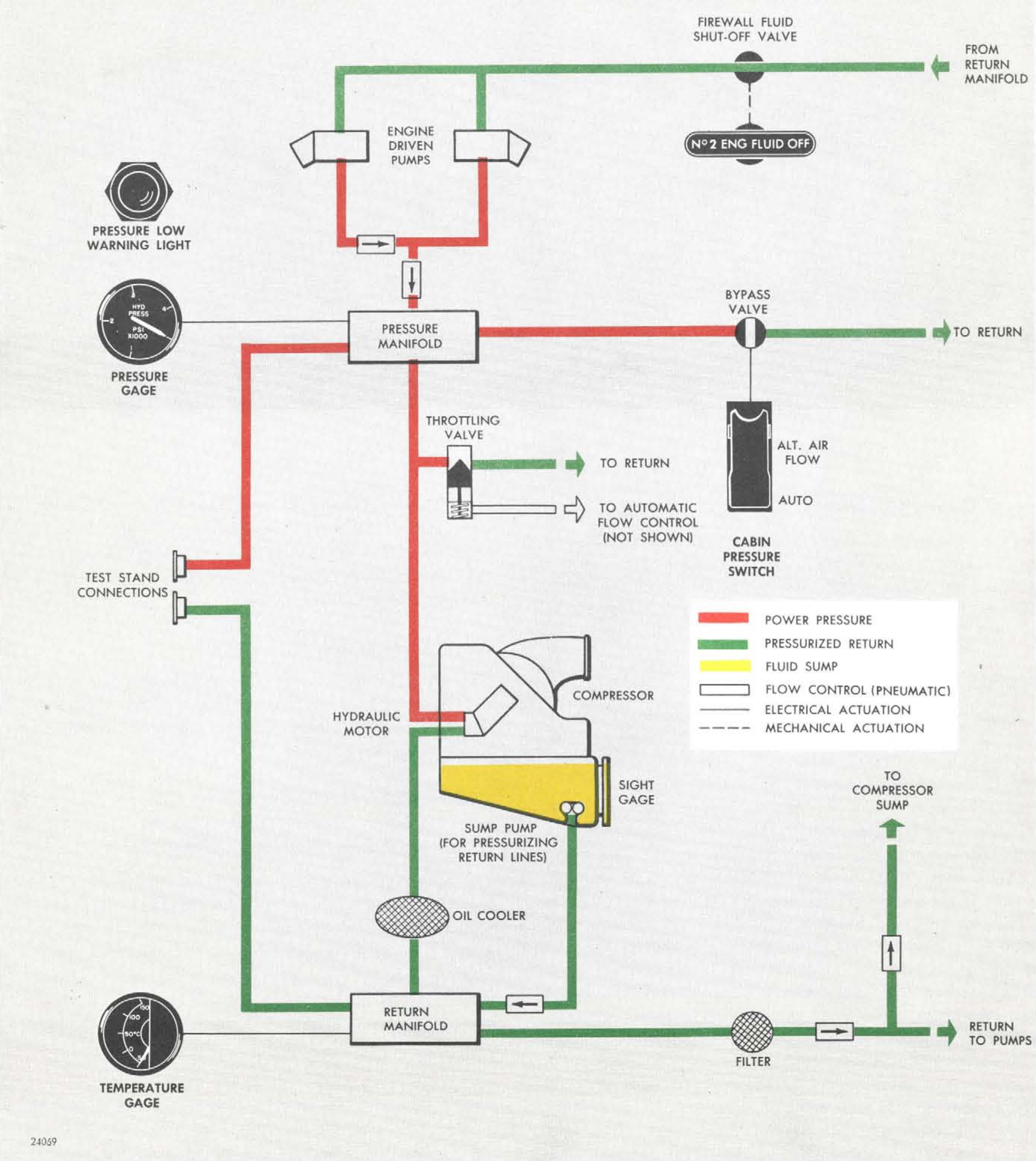


Figure 4-1

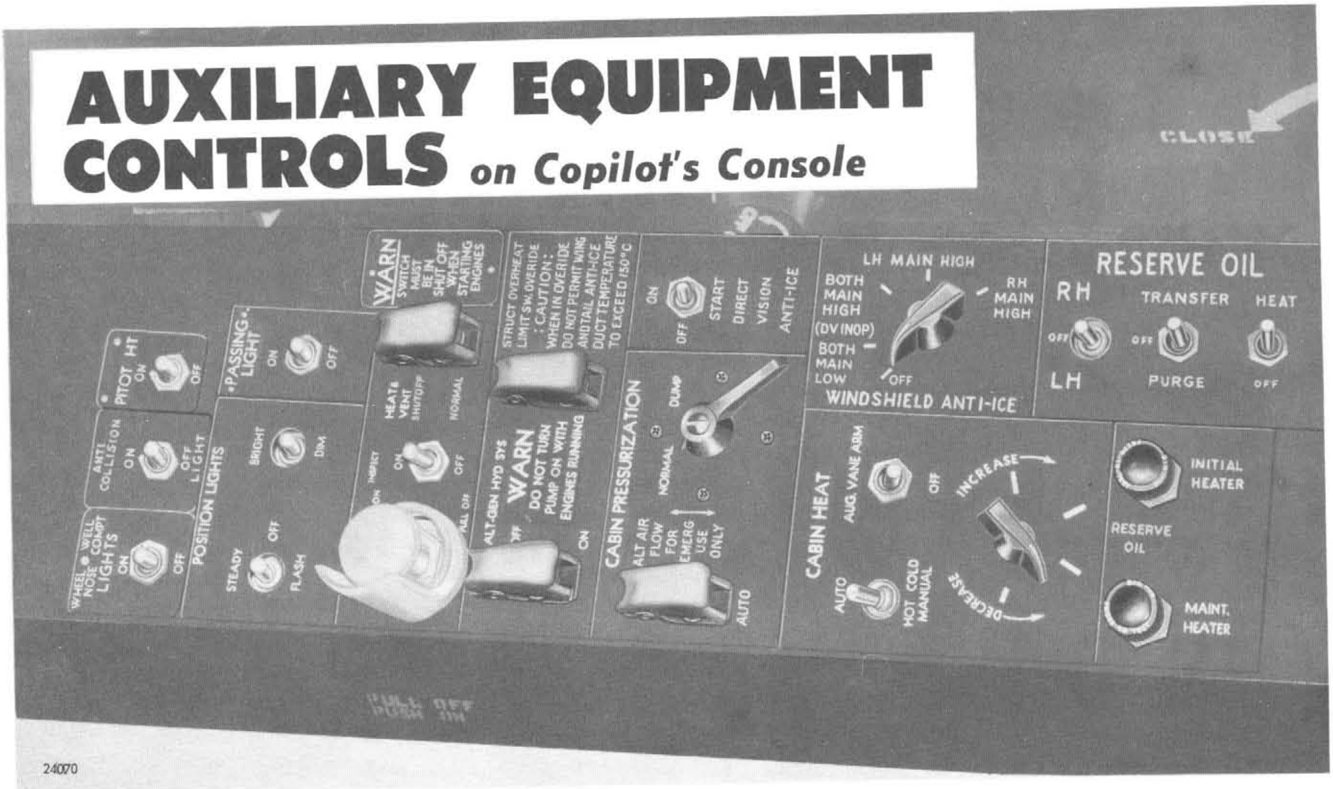


Figure 4-2

No. 2 Engine Fluid-Off Handle

A cabin pressure hydraulic fluid shutoff valve is installed at the right nacelle firewall in the return line to the two pumps. The valve is operated by the No. 2 engine fluid-off handle on the fire control panel (figure 1-37). Refer to ENGINE FIRE EXTINGUISHER SYSTEM, Section I.

Cabin Pressure Controller

A cabin pressure control panel (figure 4-3), located adjacent to the copilot's console, has a cabin pressure controller, a rate-of-climb indicator, and a cabin altimeter. The cabin pressure controller permits selection of the pressure altitude that the cabin will maintain in flight. It controls the action of the pressure regulator valves when the cabin pressurization switch is in AUTO and the manual dump valve is in NORMAL. The rate selector knob adjusts the cabin pressurization rate of change from a minimum of approximately 50 fpm to a maximum of 2000 fpm. The rate-of-climb indicator indicates the rate of change of the cabin altitude in feet per minute. A small window dial in the face of the controller indicates the maximum altitude at which the airplane may fly before maximum differential pressure of 3.5 psi is reached. Above this altitude maximum differential control is automatically maintained and cabin altitude changes in direct proportion to airplane altitude. For normal operation, prior to takeoff the desired cruising altitude should be set in the small window dial of the cabin pressure control. The indicator needle should then indicate the cabin altitude that can be maintained when operating at full differential pressure. When at set cruising altitude, the cabin pressure control indicator needle should coincide with the cabin pressure altimeter. Prior to descent, the cabin pressure controller needle should be set at the landing field elevation.

Cabin Altimeter

The cabin altimeter is provided to indicate the cabin altitude in feet. It is used to check for cabin pressurization during climb and cruise, and for the relief of cabin pressure during descent.

CABIN HEAT CONTROLS

Cabin Heat and Vent Shutoff Switch

The guarded cabin heat and vent switch (figure 4-2), located on the copilot's console, affords a means of preventing flow of fuel and oil vapors into the heating air ducts during engine starting. If the heat source valves were to remain open during engine starting, vapors could flow into the heating air ducts which would constitute a fire hazard. The cabin heat and vent switch has NORMAL and SHUTOFF positions. In the SHUTOFF position, all other electrical controls to the heat source valves are overridden and the heat source valves are closed by dc power. When in the NORMAL position, the heat source valves are controlled by the position of the augmentor vane arm switch, the heat anti-ice button, or the demands of the heating and air-conditioning system.

Cabin Heat Switch

The cabin heat switch (figure 4-2) has an AUTO position, two manual positions (HOT and COLD), and an unmarked center OFF position. In respect to the manual positions, the switch is spring-loaded to OFF. When in AUTO position, the switch powers the automatic temperature control system by connecting dc power to the valve actuating circuits of the temperature control unit. In HOT position, the cabin heat switch bypasses the temperature control unit and originates a heat demand signal of its own. This causes sequential operation of all valves toward the maximum heat condition. Holding the cabin heat switch in COLD position also bypasses the temperature control unit and supplies a cold demand signal, causing sequential operation of all valves toward the maximum cold condition. The time required to complete the full cycle from fully hot to fully cold is approximately one minute and 30 seconds. If the switch is left in the OFF position, the temperature control system is inoperative, the control rheostat is ineffective, and the valves will retain the last assumed position. For manual operation, best results are obtained by holding the switch to either of the positions momentarily, repeating as necessary to obtain the temperature desired.

Cabin Heat Rheostat

The setting of the cabin heat rheostat (figure 4-2) determines the range within which cabin temperature will be maintained automatically in flight by action of the temperature control unit when the cabin heat switch is in AUTO and the cabin pressurization switch is in AUTO. The rheostat has INCREASE and DECREASE positions. If the cabin heat switch is off, or is held in HOT or COLD position and then released, the cabin heat rheostat will have no effect and cabin temperature will not be controlled. The total range controlled by the rheostat is 55°F to 85°F. The rheostat will not be effective in obtaining a cabin temperature below outside air temperature unless the cabin pressurization switch is in AUTO position.

Cockpit Heat

The flight compartment side windshield defroster, pilots' foot warmers, and cockpit ventilating ducts are connected to the cabin heat and ventilating system. An auxiliary electric heater provides additional heat for side windshield defrosting and cockpit heat.

Pilots' Foot Warmers

Heated air from the cabin heat and ventilating system can be directed to the floor area near the rudder pedals. The foot warmers are turned on or off manually by valve control knobs located aft of the discharge nozzles on each side of the flight compartment.

Cockpit Heater Control Switch

The cockpit heater control switch on the copilot's console has four positions: OFF, LOW, MED, and HIGH. This switch controls the auxiliary electric heater which provides additional heat for side window defrosting and cockpit heat. The control circuit is dc powered from the nonessential bus and the heating elements are powered by the No. 2 unregulated ac bus.

GROUND COOLING BLOWER

An electric driven blower in the cabin ventilating system provides cooling and ventilation while the airplane is on

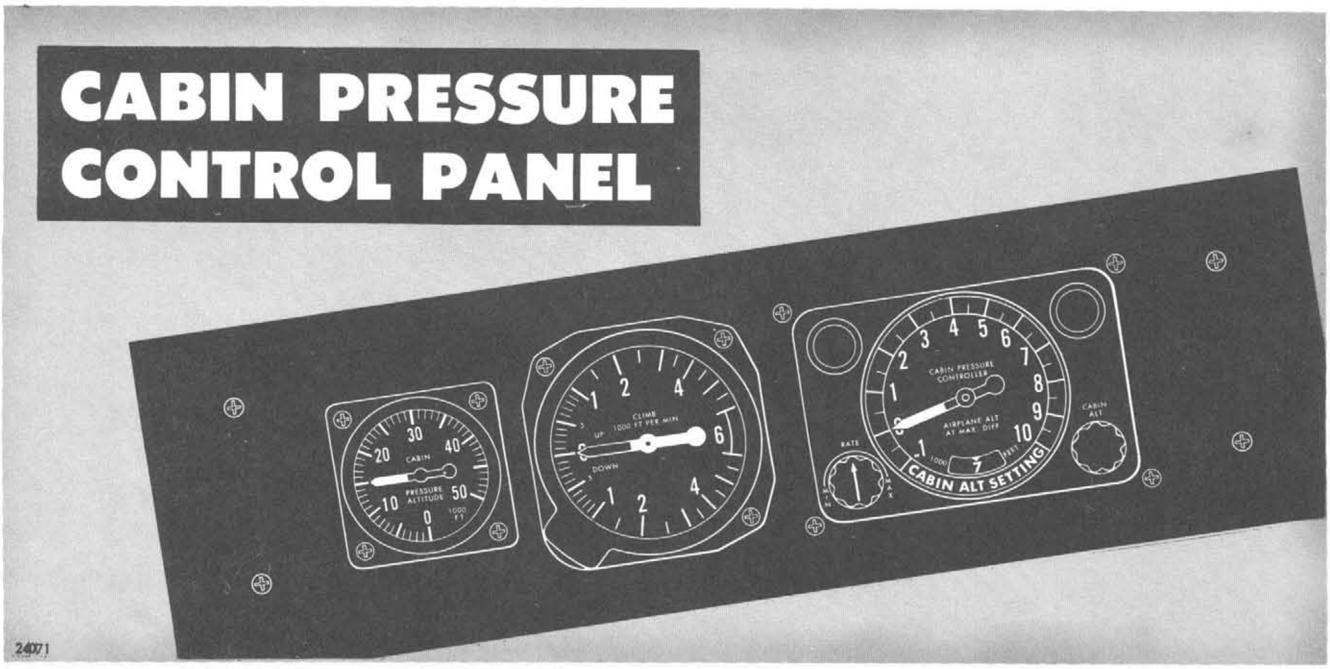


Figure 4-3

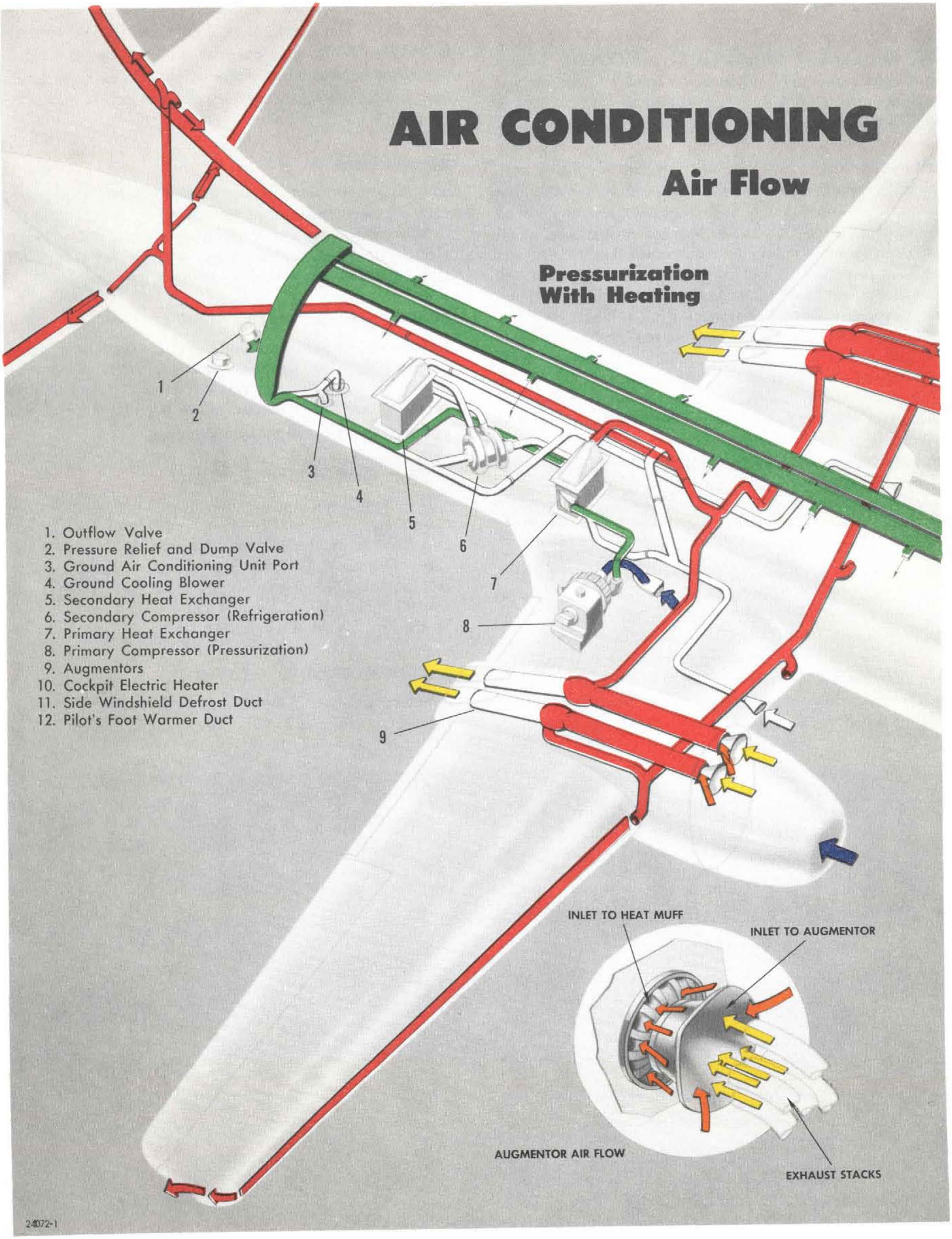
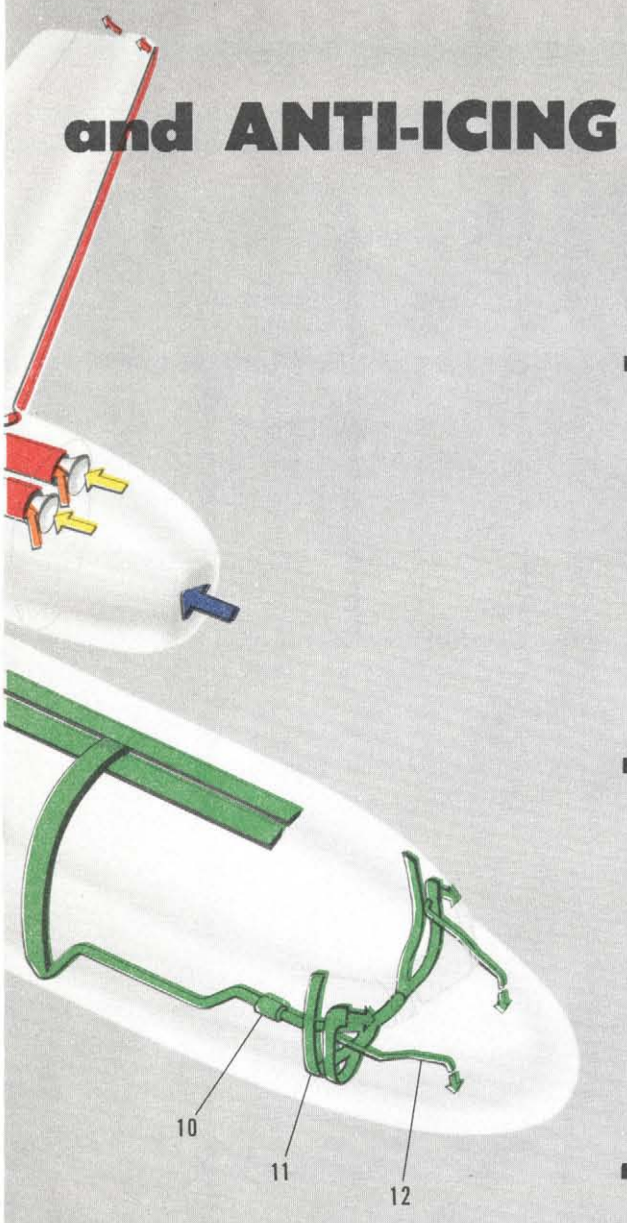
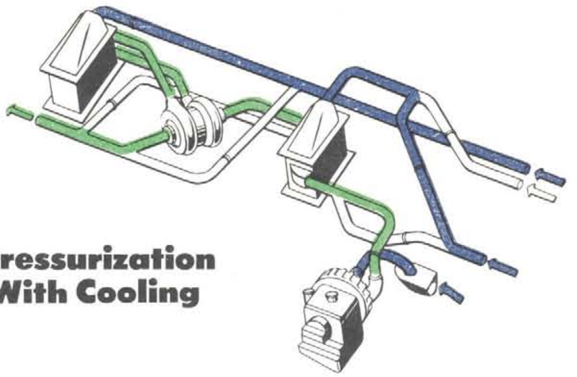

AIR CONDITIONING
Air Flow
Pressurization With Heating
1. Outflow Valve
2. Pressure Relief and Dump Valve
3. Ground Air Conditioning Unit Port
4. Ground Cooling Blower
5. Secondary Heat Exchanger
6. Secondary Compressor (Refrigeration)
7. Primary Heat Exchanger
8. Primary Compressor (Pressurization)
9. Augmentors
10. Cockpit Electric Heater
11. Side Windshield Defrost Duct
12. Pilot's Foot Warmer Duct
1
2
3
4
5
6
7
8
9
INLET TO HEAT MUFF
INLET TO AUGMENTOR
AUGMENTOR AIR FLOW
EXHAUST STACKS
24072-1

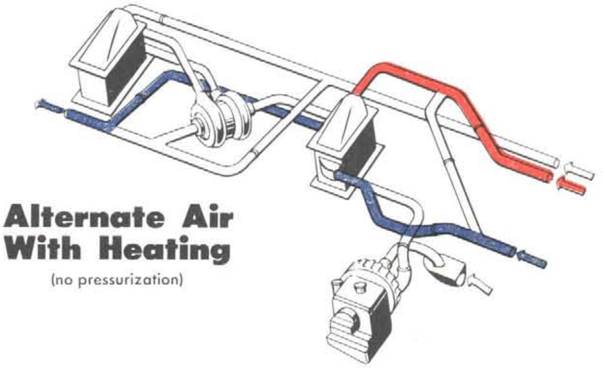
Figure 4-4

and ANTI-ICING

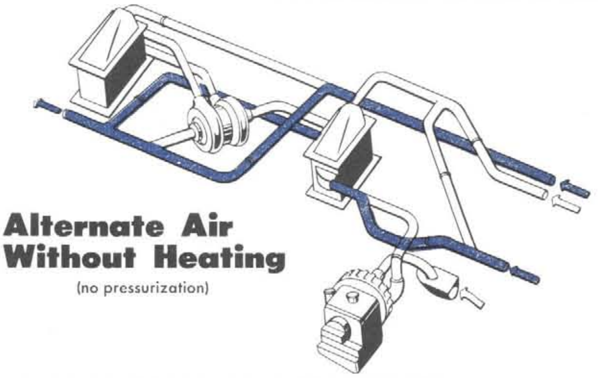




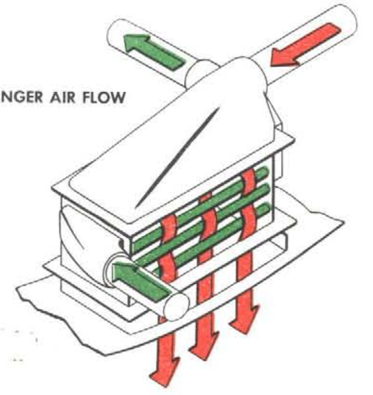
Pressurization With Cooling



Alternate Air With Heating
(no pressurization)



Alternate Air Without Heating
(no pressurization)



HEAT EXCHANGER AIR FLOW

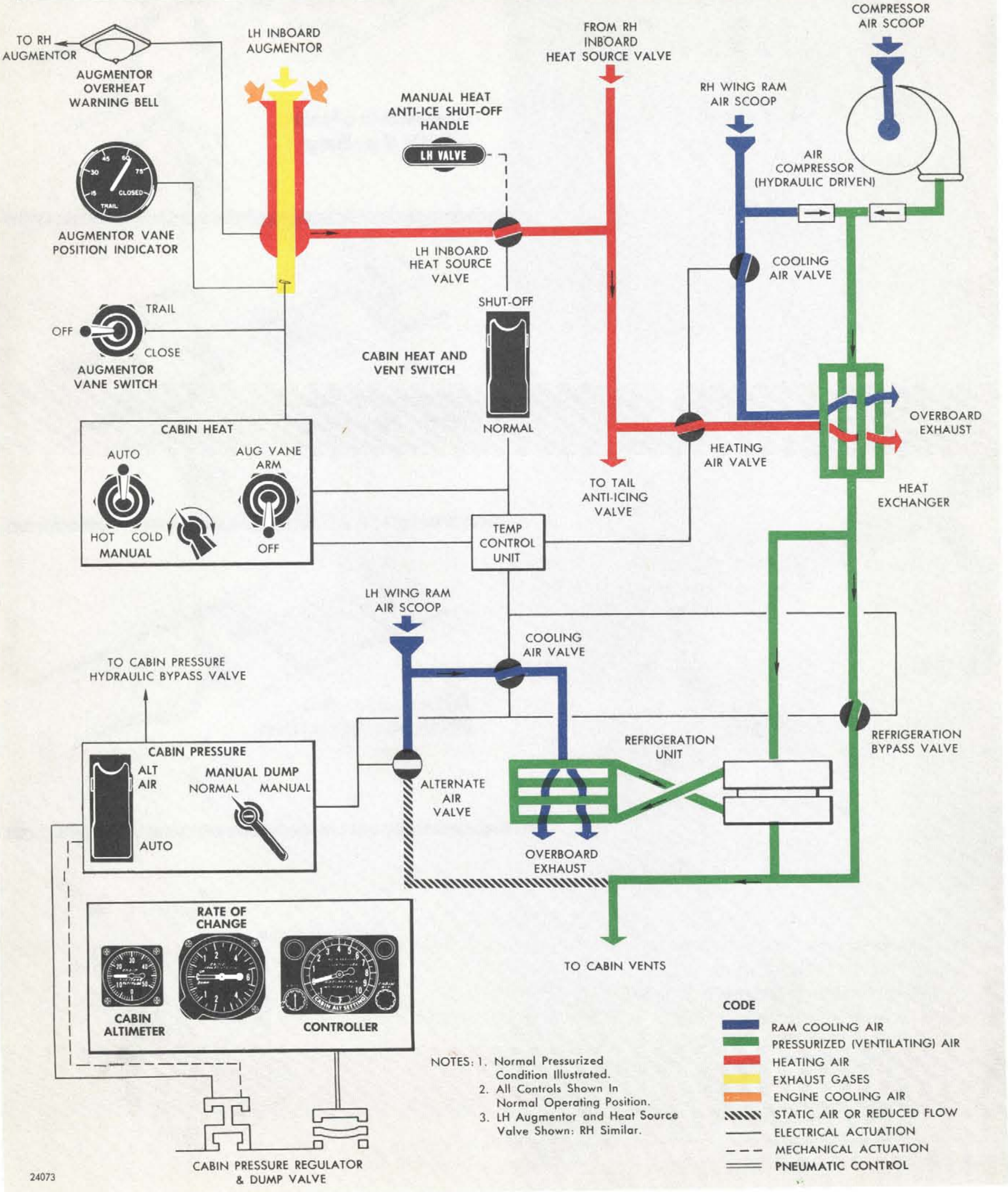
CODE

- 🟦 RAM (COOLING) AIR
- 🟨 EXHAUST GASES
- 🟧 ENGINE COOLING AIR
- 🟥 HEATING AIR
- 🟩 PRESSURIZED (VENTILATING) AIR
- ▭ STATIC AIR OR REDUCED FLOW

NOTE: For Clarity All Temperature Conditions Shown Are Maximums.

24072-2

AIR CONDITIONING SYSTEM



NOTES:
1. Normal Pressurized Condition Illustrated.
2. All Controls Shown In Normal Operating Position.
3. LH Augmentor and Heat Source Valve Shown: RH Similar.

Figure 4-5

the ground. The blower is dc powered from the external bus and is controlled by an ON-OFF switch on the cabin light switch panel.

NORMAL OPERATION OF AIR-CONDITIONING SYSTEM

Before Starting Engines

1. Manual heat anti-ice shutoff handles – Safety-wired ON.
2. No. 2 engine fluid-off handle – IN.
3. Augmentor vane position indicators – TRAIL.
4. Cabin pressure hydraulic pressure-low warning light – Check on.
5. Cabin heat and vent switch – SHUTOFF.
6. Heat anti-icing button – PULL OFF.
7. Cabin pressure manual dump handle – NORMAL.
8. Cabin pressurization switch – AUTO.
9. Cabin heat switch – AUTO.
10. Cabin heat rheostat – Set as desired.

After Starting Engines

1. Cabin heat and vent switch – NORMAL.
2. Cabin pressure hydraulic pressure-low warning light (right engine idling) – Out.
3. Cabin pressure hydraulic pressure gage (right engine operating at 2000 rpm) – 1100-1250 psi.
4. Cabin pressure hydraulic temperature gage (right engine operating at 2000 rpm) – Within limits.

Before Takeoff

1. Cabin altimeter – Check cabin altitude and field altitude for same indication – no differential.
2. Cabin altitude selector switch – Set as desired.
3. Rate of change – Set as desired.
4. Cabin heat and vent switch – NORMAL.

During Flight

1. Observe the cabin pressure hydraulic temperature gage occasionally for temperature within limits.
2. Check that cabin pressure hydraulic pressure-low warning light remains out.
3. When airplane is above selected cabin altitude, observe cabin altimeter for pressure differential within limits up to the maximum differential altitude. Select rate of change as desired.
4. Observe for cabin altitude rise in direct proportion to airplane altitude above maximum differential altitude.
5. Observe cabin altimeter for decrease in altitude and pressure differentials during descent. Set rate of change as desired.

EMERGENCY OPERATION OF AIR-CONDITIONING SYSTEM

Ventilation Failure

A flapper-type alternate air valve (figure 4-5) will open automatically and admit ventilating air to the fuselage if the air compressor of the air conditioning system ceases to operate or operates intermittently. The latter condition will be indicated by fluctuation of the cabin pressure hydraulic pressure. Further indication of malfunction of the air compressor may be lighting of the cabin pressure hydraulic pressure-low warning light, excessive temperature in the cabin pressure hydraulic system, or failure to pressurize above selected cabin altitude. Noticeable fluctuation of cabin temperature may also occur. Proceed as follows:

1. Cabin pressurization switch – ALT AIR FLOW.

CAUTION

> Do not operate cabin pressurization system until the malfunction has been corrected. Starting the compressor hydraulic system with the right engine running will cause a sudden high-pressure surge that may damage the system.

2. Descend to altitude not requiring oxygen.

Pressurization Failure

If the cabin altimeter does not indicate increasing altitude and pressure differentials as the airplane rises above selected cabin altitude, but ventilation has been satisfactory up to that altitude, check cabin pressure manual dump valve handle for NORMAL position. Note ventilation efficiency and be prepared to turn cabin pressurization switch to ALT AIR FLOW if air compressor malfunction is indicated.

Temperature Control Failure

If cabin temperature control hunts widely, or fails, check manual heat anti-ice shutoff handles for ON position, cabin heat and vent switch for NORMAL position, cabin heat switch for AUTO position, cabin heat rheostat for desired setting, and heat anti-icing button for PULL OFF position. Check inverter output for 115 volts. Check dc power supply.

Note

> Heating air from the collector muffs at the inboard augmentors is routed to tail leading edges during wing and tail anti-icing operation (heat anti-icing button in PUSH ON position). Cabin temperature may therefore drop below the desired temperature during wing and tail anti-icing operation. This is not an indication of malfunction.

If all controls are correctly positioned and temperature control failure persists, hold the cabin heat switch to HOT or COLD positions periodically, as required, to keep cabin temperature within comfortable limits. Leave the switch in the OFF position between operations. If the temperature control failure takes the form of continued low temperature, and extremely low outside air temperature is indicated, there may be insufficient heat available at the augmentor heat muffs in the nacelles. To obtain greater heat in the heating air, place the augmentor vane arm switch to ARM position and close the augmentor vanes. If cabin temperature does not rise to the desired range within five minutes, return the vanes to trail position and turn the augmentor vane arm switch to OFF.

Note

> Use of augmentor vanes to provide adequate heat for cabin heating should be necessary only in extremely cold weather. Closing the augmentor vanes raises cylinder head and augmentor temperatures. If a dangerous overheat condition develops in the augmentors, the augmentor overheat warning bell will ring and the vanes will move toward the trail position. When the overheat warning bell stops ringing, reset the augmentor vanes to a lesser closure and adjust nacelle flaps to maintain cyinder head temperatures within limits.

If attempts to increase cabin temperature by these means are not successful, the temperature control unit may be defective. Override the unit by operating the cabin heat switch to HOT and then leaving it off as described above.

Cabin Compressor Hydraulic Pressure-Low Warning Light Illuminates

If the cabin compressor hydraulic pressure-low warning light illuminates, return pressure in the cabin compressor hydraulic system is below operating limits and the cabin pressurization switch must be turned to ALT AIR FLOW to prevent damage to the system. Follow the appropriate directions under VENTILATION FAILURE or PRESSURIZATION FAILURE, this Section.

Cabin Compressor Hydraulic Temperature Exceeds Limits

If excessive temperature is indicated by the cabin compressor hydraulic temperature gage, serious malfunction of a major component of the system is indicated. Turn the cabin pressurization switch to ALT AIR FLOW and proceed as described under VENTILATION FAILURE or PRESSURIAZTION FAILURE, this Section.

Air-Conditioning Operation With Left Engine Inoperative

If the left engine fails or is shut down in flight, turn the left manual heat anti-ice shutoff handle to OFF position. If reduction of the accessory load on the right engine is required, switch cabin pressurization to ALT AIR FLOW and proceed as described under VENTILATION FAILURE or PRESSURIZATION FAILURE, this Section.

Air-Conditioning Operation With Right Engine Inoperative

If the right engine fails or is shut down in flight, turn the right manual heat anti-ice shutoff handle to OFF position, switch cabin pressurization to ALT AIR FLOW, and proceed as described under VENTILATION FAILURE or PRESSURIZATION FAILURE, this Section.

Note

> Automatic cabin temperature control may be continued (cabin heat switch in AUTO position) with either engine inoperative, although cabin temperature may decrease below the desired level. It is not advisable to attempt to raise the heating air temperature by closing the augmentor vanes, under single-engine operating conditions, however, as cylinder head temperature would then rise rapidly above operating limits.

CABIN TEMPERATURE CONTROL DURING WING AND TAIL ANTI-ICING OPERATION

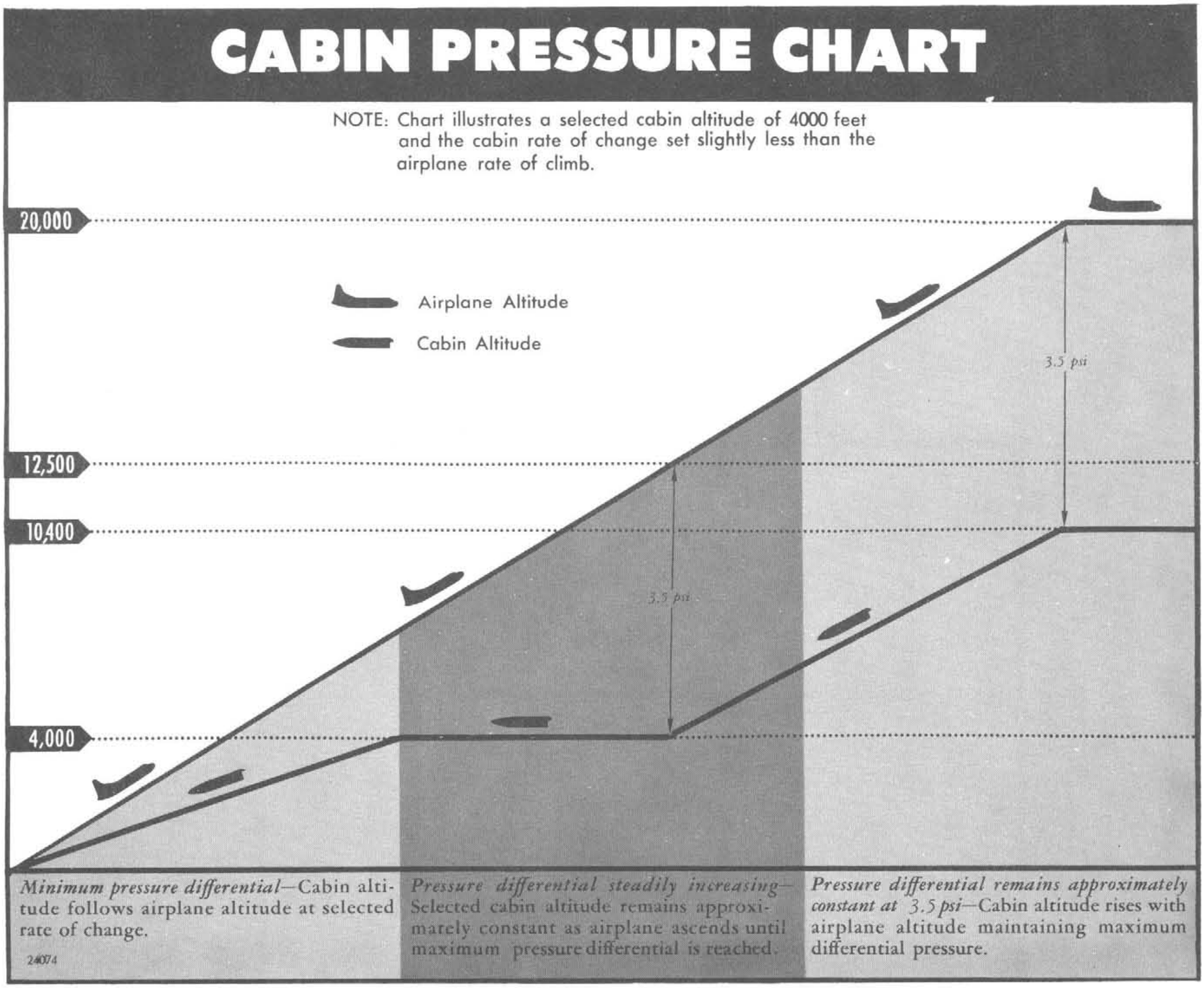
During wing and tail anti-icing, heated air from the inboard augmentor muff is shared between cabin heating and tail leading edges. The only other heat then available for cabin heating is the heat generated in the ventilating-pressurizing air as it is compressed by the air compressor. To obtain the maximum benefit from this heat, leave all air-conditioning controls set for normal automatic operation. Discontinue wing and tail anti-icing operation as soon as it is safe to do so.

CAUTION

> Do not discontinue wing and tail anti-icing operation prematurely or interrupt it periodically for the sake of heating the cabin. The benefit of heat soaking the wing and tail leading edges prior to encountering icing is lost in a few moments of nonoperation.

SIDE WINDOW DEFROSTING

The flow of air from the cabin heat and ventilating system is directed against the side windows. The defrosting air to either window can be turned on or off by manual control handles on the flight compartment floor outboard of the pilot's and copilot's seats. Additional heat can be obtained with the cockpit heater control switch.



CABIN PRESSURE CHART

NOTE: Chart illustrates a selected cabin altitude of 4000 feet and the cabin rate of change set slightly less than the airplane rate of climb.

Minimum pressure differential—Cabin altitude follows airplane altitude at selected rate of change.

Pressure differential steadily increasing—Selected cabin altitude remains approximately constant as airplane ascends until maximum pressure differential is reached.

Pressure differential remains approximately constant at 3.5 psi—Cabin altitude rises with airplane altitude maintaining maximum differential pressure.

Figure 4-6

ANTI-ICING AND DE-ICING SYSTEMS

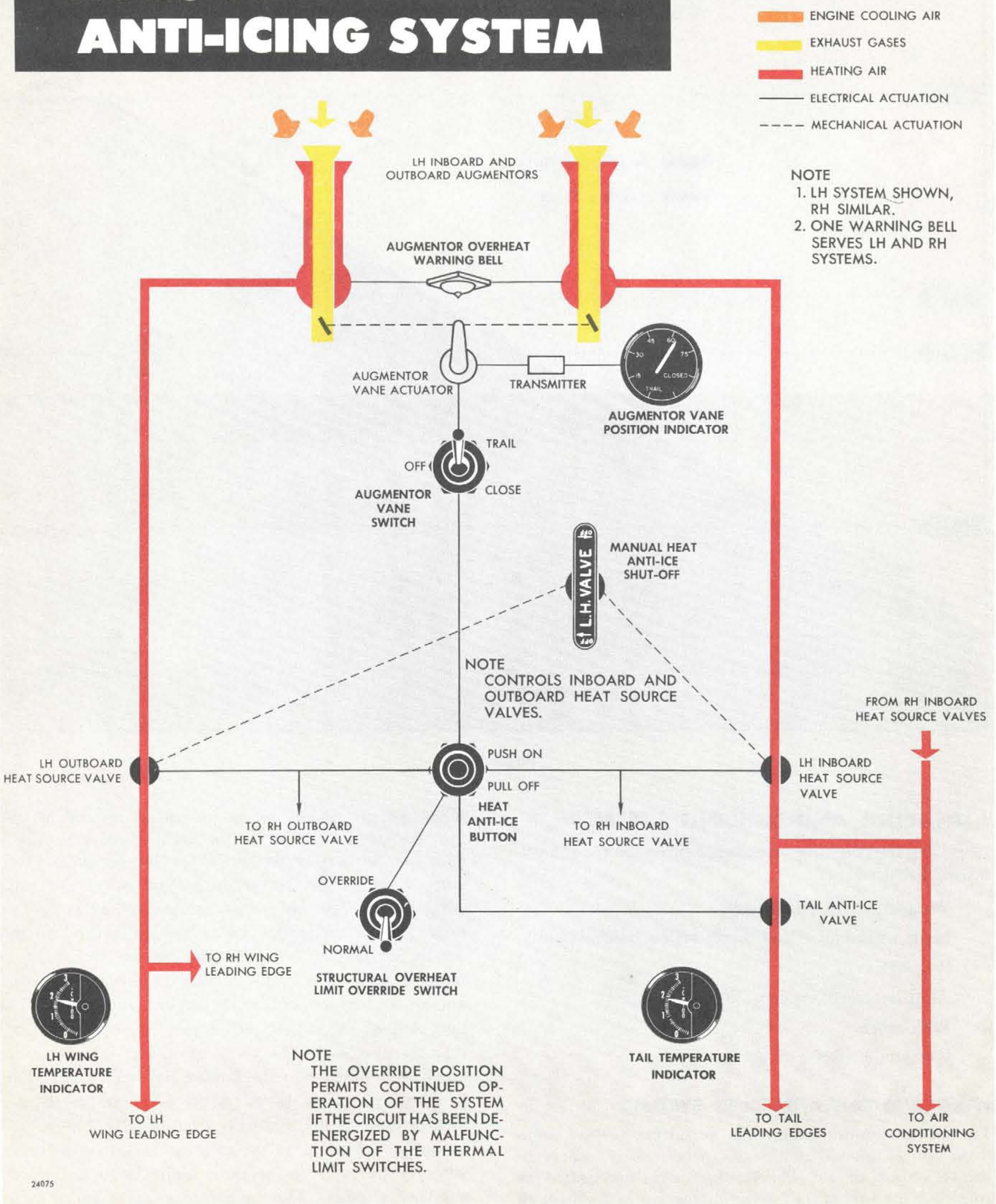
Anti-icing and de-icing systems are provided for the following installations:

- Wing and tail leading edges
- Main windshields and direct vision windshields
- Propellers
- Alternator-generator cooling air scoops
- Pitot tubes
- Carburetor (Refer to Section VII)

WING AND TAIL ANTI-ICING SYSTEM

The leading edges of the wing, dorsal fin, vertical stabilizer, and horizontal stabilizer can be heated to prevent the formation of ice. The leading edges are heated by routing hot air from the engine augmentor muffs through integral ducts in the leading edge structures. (See figure 4-7.) Each engine has an outboard augmentor and an inboard augmentor. When it is necessary to heat the leading edges, hot air from the outboard augmentor muff in each nacelle is directed into the anti-icing ducts in the wing leading edge. The leading edge ducts in the right wing and the left wing are interconncted by a crossover duct so that the leading edges of both wings can be heated during single-engine operation. Heated air from the inboard augmentor muffs in both nacelles enters a fore-and-aft duct which leads to the tail anti-icing ducts. (This duct also serves the heat exchanger of the cabin air-conditioning system.) The flow of heated air from the augmentor muffs into the heated air ducts is controlled by four heat source valves (figure 4-7), one at each augmentor muff. A tail anti-icing shutoff valve (figure 4-7), in the duct leading to the tail, operates in conjunction with the heat source valves to supply heated air to the tail leading edges. The temperature of the anti-icing air can be increased by varying the position of the augmentor vanes. Thermal switches at the augmentors automatically

WING AND TAIL ANTI-ICING SYSTEM


ENGINE COOLING AIR
EXHAUST GASES
HEATING AIR
ELECTRICAL ACTUATION
MECHANICAL ACTUATION
LH INBOARD AND OUTBOARD AUGMENTORS
AUGMENTOR OVERHEAT WARNING BELL
AUGMENTOR VANE ACTUATOR
TRANSMITTER
AUGMENTOR VANE POSITION INDICATOR
15
30
45
60
75
CLOSED
TRAIL
TRAIL
OFF
CLOSE
AUGMENTOR VANE SWITCH
L.H. VALVE
MANUAL HEAT ANTI-ICE SHUT-OFF
FROM RH INBOARD HEAT SOURCE VALVES
LH OUTBOARD HEAT SOURCE VALVE
PUSH ON
PULL OFF
HEAT ANTI-ICE BUTTON
LH INBOARD HEAT SOURCE VALVE
TO RH OUTBOARD HEAT SOURCE VALVE
TO RH INBOARD HEAT SOURCE VALVE
OVERRIDE
NORMAL
STRUCTURAL OVERHEAT LIMIT OVERRIDE SWITCH
TAIL ANTI-ICE VALVE
TO RH WING LEADING EDGE
LH WING TEMPERATURE INDICATOR
TAIL TEMPERATURE INDICATOR
TO LH WING LEADING EDGE
TO TAIL LEADING EDGES
TO AIR CONDITIONING SYSTEM
24075

NOTE
1. LH SYSTEM SHOWN, RH SIMILAR.
2. ONE WARNING BELL SERVES LH AND RH SYSTEMS.

NOTE
CONTROLS INBOARD AND OUTBOARD HEAT SOURCE VALVES.

NOTE
THE OVERRIDE POSITION PERMITS CONTINUED OPERATION OF THE SYSTEM IF THE CIRCUIT HAS BEEN DE-ENERGIZED BY MALFUNCTION OF THE THERMAL LIMIT SWITCHES.

Figure 4-7

trail the augmentor vanes and ring a warning bell in the cockpit if an overheat condition occurs in the augmentors. If an overheat condition occurs in the ducts, thermostatic limit switches in the wing and tail anti-icing ducts automatically trail the augmentor vanes and close the outboard heat source valves and the tail anti-icing valve, regardless of the position of the augmentor vane arm switch.

INTERRELATION OF WING AND TAIL ANTI-ICING SYSTEM AND AIR-CONDITIONING SYSTEM

The inboard heat source valves (figure 4-7) are controlled by either the cabin temperature control circuit of the air-conditioning system, or the wing and tail anti-icing system control circuit. The outboard heat source valves (figure 4-7) are controlled by the augmentor vane arm switch, or by the wing and tail anti-icing system. The tail anti-icing shutoff valve (figure 4-7) is controlled by the wing and tail anti-icing system control circuit only. When the wing and tail anti-icing control circuit is not energized, the cabin temperature control circuit opens or closes the heating air valve and the inboard heat source valves together so that the required amount of heating air is supplied to the heat exchanger-intercooler of the air-conditioning system. In this condition, the outboard heat source valves and the tail anti-icing shutoff valve remain closed. During anti-icing operation, if an anti-icing duct becomes overheated, an automatic duct overheat circuit deenergizes the anti-icing control circuit. The augmentor vanes trail, the outboard heat source valves and the tail anti-icing shutoff valve close, and control of the inboard heat source valves and the heating air valves reverts to the cabin temperature control system.

Heat Anti-Icing Button

The heat anti-icing button (figure 4-2), on the copilot's console, controls the operation of the wing and tail anti-icing system. The button has positions PUSH ON and PULL OFF. When the button is in the PULL OFF (out) position, the outboard heat source valves are controlled by the augmentor vane arm switch, the tail anti-icing shutoff valve is closed, and the inboard heat source valves and the heating air valve are under control of the cabin temperature control system. When the heat anti-icing button is in the PUSH ON (in) position, all four heat source valves and the tail anti-icing shutoff valve are opened and the augmentor vane control circuits are automatically armed. The button is pulled out manually when anti-icing is no longer required. Then the valves and the augmentor vane circuits revert to the closed and deenergized conditions described above.

Structural Overheat Limit Override Switch

A guarded override switch (figure 4-2), on the copilot's console, permits continued operation of wing and tail anti-icing if the control circuit becomes deenergized through actuation of one or more of the duct thermal limit switches for any reason other than an overheat condition. If the heat anti-ice button will not stay in the PUSH ON position and the wing and tail anti-ice temperatures are within limits, operation of heat anti-ice can be continued by placing the override switch in the OVERRIDE position and the heat anti-ice switch in the PUSH ON position.

CAUTION

When wing and tail anti-icing is being accomplished through use of the override switch, the automatic overheat disconnect is inoperative. Duct temperatures should not be allowed to exceed the maximum limits.

Cabin Heat and Vent Switch

The cabin heat and vent switch (figure 4-2), on the copilot's console, controls the operation of the heat source valves. In the SHUTOFF position the valves are closed and heat is not available for anti-icing and cabin heat. When the switch is in the guarded NORMAL position, the valves are controlled by normal automatic or manual operation.

Manual Heat Anti-Ice Shutoff Handles

Two handles, mounted on a recessed overhead panel (figure 4-8), are provided for manually closing or opening the heat source valves at the augmentors if the electrical control circuits for these valves fail. These handles are safetied in the ON position. One handle is provided for the two heat source valves in each nacelle, and is connected to the valves by a cable system. A handle is pulled downward to engage its clutch mechanism and is then rotated 100° clockwise to close the heat source valves in the corresponding nacelle. When the handle has reached the OFF position, it should be pushed into the detent provided to hold the handle in the valves-closed position.

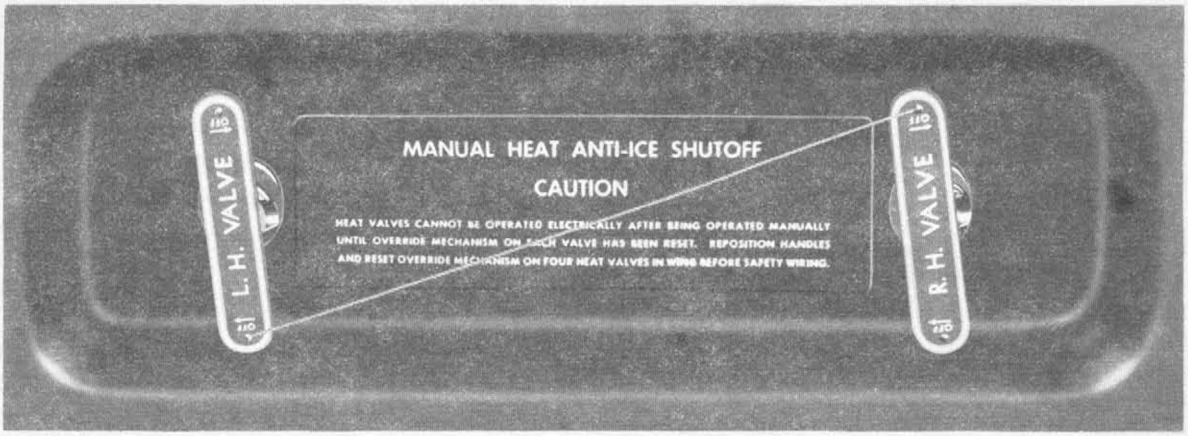
Note

Once the heat source valves have been operated manually, they cannot be operated electrically until the valve actuators have been reset by the ground crew. Notation should be made on Form 781 when a manual heat anti-ice shutoff handle has been used.

If the heat source valves have been manually closed, they can be opened by pulling the handles down and rotating them counterclockwise to the open position. If the valves are in the closed position when electrical failure occurs, they can be opened by pulling the handles down, rotating them clockwise to the closed position, and then rotating them counterclockwise back to the normal position.

Augmentor Vane Arm Switch

The augmentor vane arm switch (figure 4-2), on the copilot's console, has OFF and ARM positions. It is normally used when the wing and tail anti-icing system is


MANUAL HEAT ANTI-ICE SHUTOFF
CAUTION
HEAT VALVES CANNOT BE OPERATED ELECTRICALLY AFTER BEING OPERATED MANUALLY UNTIL OVERRIDE MECHANISM ON EACH VALVE HAS BEEN RESET. REPOSITION HANDLES AND RESET OVERRIDE MECHANISM ON FOUR HEAT VALVES IN WING BEFORE SAFETY WIRING.
OFF
L. H. VALVE
OFF
OFF
R. H. VALVE
OFF

MANUAL HEAT ANTI-ICE SHUT-OFF HANDLES

24076

Figure 4-8

not in operation. The augmentor vane arm switch, when positioned to ARM, allows operation of the augmentor vanes without simultaneously operating the wing and tail anti-icing system. The switch is overridden and has no effect when the heat anti-ice button is in PUSH ON position. The augmentor vane control circuits are then armed regardless of the position of the augmentor vane arm switch. The outboard heat valve of each nacelle will open when the arm switch is placed in the ARM position, preventing overheating of the augmentor tubes.

Augmentor Vane Switches

When the heat anti-icing control button is in the PUSH ON position, or when the augmentor vane arm switch is in ARM position, the temperature of the heated air delivered to the anti-icing ducts can be increased by operating the augmentor vane switches (figure 1-9) to close the augmentor vanes. The augmentor vanes are dc actuated.

Wing and Tail Anti-Icing Temperature Gages

Three temperature gages (9, 11, 12, figure 1-7), on the pilot's instrument panel skirt, indicate the temperature of the anti-icing air in the leading edge ducts of the wing and tail. The gages are powered by the dc essential bus, transmitted through temperature bulbs installed in the wing and tail leading edges.

Augmentor Vane Position Indicators

Two augmentor vane position indicators (33, figure 1-7) are installed on the engine instrument panel. Each indicator shows the position of the two augmentor vanes in the corresponding nacelle. The position is indicated in degrees closed. The indicator circuits are controlled by the mechanism that links and actuates the two augmentor vanes. The indicators function at all times that 26-volt ac (transformer) power is available.

Augmentor Overheat Warning Bell

The augmentor overheat safety circuit returns the augmentor vanes toward the trail position and rings a warning bell on the flight compartment ceiling when an overheat condition exists in an augmentor. There is no cutoff switch for the warning bell, and it continues to ring as long as the overheat condition exists. The warning bell is powered by the emergency dc bus.

WARNING

The fire detector circuit breaker must not be pulled to silence the augmentor overheat warning bell. If the circuit breaker is pulled out, the fire detection system is inoperative.

NORMAL OPERATION OF WING AND TAIL ANTI-ICING SYSTEM

1. At least 30 minutes before leading edge icing is anticipated, push the heat anti-icing button to PUSH ON position.
2. When icing conditions are encountered, close the augmentor vanes to full close position and adjust nacelle flaps to maintain cylinder head temperatures within limits.
3. Reset augmentor vanes to a lesser closure if nacelle flap MID POSITION does not maintain cylinder head temperatures within limits.
4. When leading edge anti-icing is no longer necessary, pull out heat anti-icing button.

Note

On the ground, airflow into the augmentor muffs is insufficient to provide wing and tail anti-icing.

EMERGENCY OPERATION OF WING AND TAIL ANTI-ICING SYSTEM

Malfunction of Heat Source Valve Electrical Control Circuits

1. To open the heat source valves, pull the manual heat anti-ice handles (located on a recessed overhead panel), rotate them clockwise to the off position, and then counterclockwise back to the normal position.

2. To close the heat source valves, pull the manual heat anti-ice handles and rotate them clockwise to the off position.

CAUTION

Once the heat source valves have been operated manually, they cannot be operated electrically until the valve actuators have been reset by a ground crew. A notation should be made on Form 781 when manual heat anti-ice shutoff has been used.

Failure of Heat Anti-Ice Button to Remain In

1. Check the circuit breaker.
2. If the circuit breaker is set, place the structural overheat limit override switch in the OVERRIDE position and push in the anti-ice button. If failure of the anti-ice button to remain in was caused by malfunction of the anti-icing duct thermal limit circuit, the button should remain in and the system will function.

CAUTION

When using the override switch, the automatic duct-overheat disconnect is inoperative. Duct temperature should not be allowed to exceed limits.

Augmentor Overheat Condition

If augmentor overheat conditions persist with augmentor vanes in trail position, reduce power of both engines until overheat warning bell stops ringing.

WARNING

The circuit breaker that protects the augmentor overheat warning bell circuit also protects the fire detection circuit. This circuit breaker must not be pulled to silence the warning bell. Such action would make the fire detection circuit inoperative.

WINDSHIELD ANTI-ICING SYSTEM

Icing of the main windshields and the two direct-vision windshields is prevented by heating the glass electrically with ac power. The windshield anti-icing circuit is identified on the circuit breaker panel as the "Nesa Control" circuit. Current for heating the glass is taken from the No. 1 alternator bus. To prevent damage to the glass from thermal shock, 115-volt alternator output is used for warming the glass from a cold start. After about ten minutes, the voltage may be manually stepped up to 325 volts. DC power is employed for operating three temperature control units (one for each main windshield and one for the direct-vision windshield panels). Temperature-sensing elements of the wire grid type, embedded in the vinyl layer of the glass panels, operate to maintain the panels at a minimum temperature of about 29.4°C (85°F). At approximately 32.2°C (90°F), power to the glass is automatically turned off to prevent damage by overheating. The system thus cycles between the temperature limits noted. A circuit breaker on the main circuit breaker panel and fuses in the fuse box below the circuit breaker panel protect the circuits from overload.

Windshield Anti-Ice Switches

Two windshield anti-ice switches (figure 4-2) are located on the copilot's console. A rotary windshield anti-ice switch controls the power to both the main windshields. It has OFF, BOTH MAIN LOW, BOTH MAIN HIGH (DV INOP) LH MAIN HIGH, and RH MAIN HIGH positions. The switch is turned to the BOTH MAIN LOW position for an initial warmup period of ten minutes, after which full anti-icing heat is obtained by turning the switch to BOTH MAIN HIGH (DV INOP) if required. Full heat selection can also be made for either windshield by turning the switch to LH MAIN HIGH or RH MAIN HIGH as desired. A three-position toggle switch, with OFF, START, and ON positions controls power to the direct-vision windshields. The switch is placed in the START position for the initial warmup period of ten minutes, and then to the ON position for full heat application if required.

Note

When the main windshield anti-ice switch is in the BOTH MAIN HIGH (DV INOP) position, the direct-vision panel current is automatically cut off to prevent overloading the No. 1 bus.

When either or both of the switches are placed in the low settings, sufficient anti-icing heat is provided to withstand outside air temperature as low as −34°C (−30°F).

CAUTION

Under all but extreme conditions, the low settings provide sufficient heat for windshield anti-icing if heat is applied several minutes

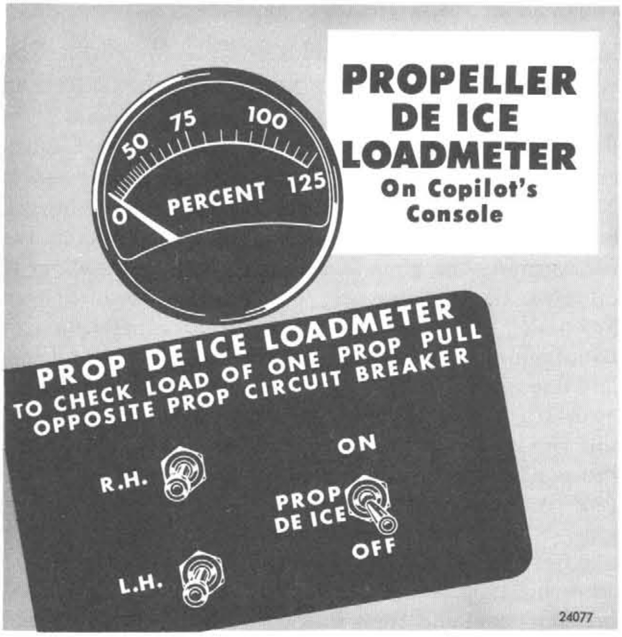


Figure 4-9

before icing conditions are encountered. Unwarranted use of high settings can cause excessive stress and may result in failure of the glass.

OPERATION OF WINDSHIELD ANTI-ICING SYSTEM

1. Alternator switches – ON.
2. Alternator selector switch – NORMAL (for ground operation, EXT PWR ON BUS 1).
3. Windshield anti-ice switch – BOTH MAIN LOW for ten minutes; then BOTH MAIN HIGH (DV INOP) if required.
4. DV anti-ice switches – START, for ten minutes; then ON if required.

Note

- If the No. 1 alternator fails, and windshield anti-icing is necessary, turn the alternator selector switch to the 1 OFF-2 ON BUS 1 position to supply current from the No. 2 alternator to the windshield anti-icing circuit.
- When the alternator switch is placed in the 1 OFF-2 ON BUS 1 position, the No. 2 alternator bus receives no current. See figure 1-26.

PROPELLER DE-ICING SYSTEM

Electrical heating elements installed inside the leading edges of the propeller blades receive power through a de-icing timer. The timer directs current to the propellers in cycles so that they are intermittently heated to loosen ice and free it for removal by centrifugal force. AC power (115-volt) from No. 1 alternator bus is stepped down to 29.5-volt ac power for operation of the propeller heating elements in the blades.

Propeller De-Ice Switch

A propeller de-ice breaker switch (12, figure 1-7) is located on the copilot's console. The switch has ON and OFF positions, and controls operation of the propeller de-icing system. This switch simultaneously controls the alternator-generator cooling scoops de-icing system. Refer to ALTERNATOR-GENERATOR COOLING SCOOPS DE-ICING SYSTEM, this Section. The switch also serves as a circuit breaker to protect the dc circuits to the de-ice timer and de-ice control relays. Do not energize the system unless the engine is operating, to prevent damage to the heating elements.

Propeller De-Ice Circuit Breakers

Two trip-free propeller de-ice circuit breakers (12, figure 1-6), placarded "LH" and "RH," are located on the copilot's console beside the propeller de-ice switch. These two circuit breakers are connected to relays that open if the heating elements in the propeller blades are subjected to excessive current. An overload in the de-icing circuit for one propeller opens the corresponding relay and causes the related trip-free circuit breaker on the copilot's console to pop out, indicating the overloaded condition. The circuit breaker can not be made to stay in the reset (in) position until the relay has cooled. About one minute may be required for the relay to cool before the circuit breaker will stay in the reset position. Additional protection is provided by the propeller de-ice circuit breaker on the main circuit breaker panel.

Propeller De-Ice Loadmeter

A propeller de-ice loadmeter (figure 4-9) is installed on the copilot's console adjacent to the propeller de-ice switch. The dial of the loadmeter is calibrated in percentage of electrical load, from 0% to 125%. When the propeller de-ice system is operating, the needle of the loadmeter indicates alternately from 0% to approximately 90% each time the propeller de-ice timer directs current to a propeller. The loadmeter indicates when the three heating elements of a propeller are drawing the normal amount of alternating current required to de-ice the blades uniformly.

NORMAL OPERATION OF PROPELLER DE-ICING SYSTEM

1. Alternator switches – ON.
2. Alternator selector switch – NORMAL.
3. Propeller de-ice circuit breakers – Check in.
4. Propeller de-ice switch – ON.
5. AC voltmeter selector switch – ALTRN NO. 1.
6. AC voltmeter – Periodic fluctuation of pointer indicates operation of propeller de-ice timer.
7. A periodic loadmeter indication of 60 seconds duration showing approximately 90% and 60 seconds off, or 0%, indicates normal operation of both propeller de-icing systems.

EMERGENCY OPERATION OF PROPELLER DE-ICING SYSTEM

Abnormal operation of the propeller de-icing system is indicated when one or both of the circuit breakers on the copilot's console is tripped or when the propeller de-ice switch trips to the OFF position. Failure of a circuit breaker to stay reset indicates that de-icing is impossible for the corresponding propeller. A top reading as low as 60% on the propeller de-ice loadmeter indicates that the blades of one propeller are not being de-iced uniformly. Determine which propeller is affected by pulling out first one and then the other circuit breaker on the console while observing the loadmeter. Leave the circuit breaker for the affected propeller in the out position.

WARNING

When uneven de-icing of the blades of a propeller is indicated, it is imperative that the de-icing circuit for that propeller be broken. Uneven de-icing of blades can result in propeller unbalance and engine failure.

Note

- If No. 1 alternator fails and propeller de-icing is necessary, turn alternator selector switch to 1 OFF-2 ON BUS 1 position and operate propeller de-icing system in normal manner.
- When the alternator selector switch is placed in the 1 OFF-2 ON BUS 1 position, No. 2 alternator bus receives no current. See figure 1-26.

ALTERNATOR-GENERATOR COOLING SCOOPS DE-ICING SYSTEM

Electrical de-icing boots are installed on the leading edges of the alternator-generator cooling air scoop on the right nacelle, and the alternator-generator hydraulic fluid cooler air scoop in the right wing lower surface. AC power (115-volt) from No. 1 alternator bus is used for the boot heaters. The circuits are manually controlled by operation of the propeller de-ice switch, but are also automatically armed or disarmed by a landing gear safety switch so that the scoop de-icers cannot normally be operated on the ground.

Alternator-Generator Cooling Scoops De-Icing System Control

When the weight of the airplane is off the landing gear, the scoop de-icing system is turned on and off with the propeller de-icing system by means of the propeller de-ice switch on the copilot's console. The scoop de-icing system has its own fuse and is not controlled by any of the propeller de-icing system circuit breakers except the propeller de-ice switch. Refer to PROPELLER DE-ICE SWITCH, this Section.

NORMAL OPERATION OF ALTERNATOR-GENERATOR COOLING SCOOPS DE-ICING SYSTEM

1. Alternator switch – ON.
2. Alternator selector switch – NORMAL.
3. Propeller de-ice switch – ON.

Note

- If the No. 1 alternator fails and de-icing is necessary, turn alternator selector switch to 1 OFF - 2 ON BUS 1 position, and operate the propeller de-ice switch in a normal manner.
- When the alternator selector switch is placed in the 1 OFF - 2 ON BUS 1 position, the No. 2 alternator bus receives no current. See figure 1-26.

PITOT TUBES ANTI-ICING SYSTEM

Each of the pitot tubes incorporates an electric heating element that is energized with 28-volt dc power for anti-icing.

Pitot Heat Switch

An ON-OFF pitot heat switch (30, figure 1-6) on the copilot's console controls electric power for heating elements in the pitot tubes. A pitot heat circuit breaker on the auxiliary circuit breaker panel safeguards the circuit.

COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

The communication and associated electronic equipment (figure 4-10) in this airplane falls into two categories: communication electronic equipment, and electronic equipment used for flight operation purposes. Circuit breakers for each item of equipment are located on the radio junction box on the radio rack. Static dischargers are located on the wing and empennage trailing edges. Some communication and electronic equipment is nonessential to safe flight, and is subject to being disconnected automatically from the airplane power source by the load monitoring system when a generator fails in flight. The disconnect may be overridden and the equipment reconnected by moving the load monitor switch to OVERRIDE if continued use of communication equipment is required by a flight emergency. See figure 1-21 for nonessential radio equipment.

Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, the radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

TABLE OF COMMUNICATION AND

TYPE AND DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
	COMMUNICATION EQUIPMENT		
Interphone AN/AIC-10	Intraplane communication and radio set reception	Within airplane	Control panel at each crew position and attendants station
HF Communication Collins 18S4	Long range code or voice communication	500-1500 miles	Radio remote control panel
VHF Communication AN/ARC-36	Air-to-air and air-to-ground communications	Line of sight	Radio remote control panel
UHF Communication AN/ARC-27	Air-to-air and air-to-ground communications	Line of sight	Radio remote control panel
Emergency Transmitter AN/CRT-3	Transmit emergency signals from life raft, from ground, or from airplane in flight	100-500 miles on low frequency (500KC); 1000-2000 miles on high frequency (8364 KC)	On transmitter
IFF/SIF AN/APX-25	Automatic airplane identification	Line of sight	Radio remote control panel

24078-1

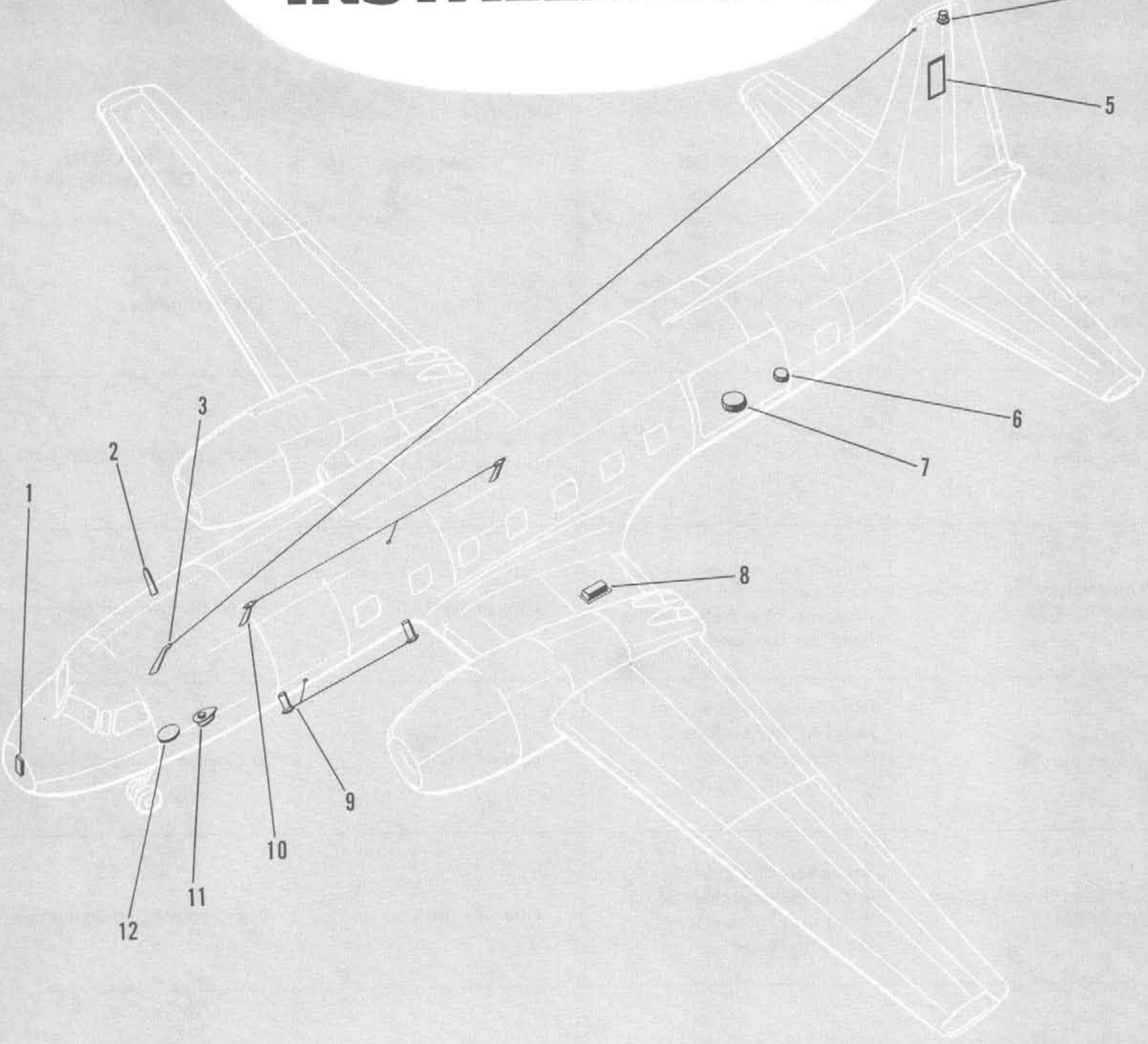
Figure 4-10

ASSOCIATED ELECTRONIC EQUIPMENT

TYPE AND DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
Emergency Receiver-Transmitter AN/URC-4	Transmit and receive signals from life raft, from ground or from airplane in flight.	Line of sight	On transmitter
Radio Compass AN/ARN-6	Reception of visual and aural signals for direction bearing and homing	20-200 miles depending on frequency and time used	Radio remote control panel
Direction Finder Group AN/ARA-25	Provides continuous visual indication of the relative direction of a radio station from the airplane	Line of sight	Radio remote control panel
TACAN AN/ARN-21	Used in conjunction with TACAN surface beacon to provide bearing and range information.	Line of sight	Radio remote control panel
Omnidirectional Range AN/ARN-14	Reception of signals for visual and aural indicators of all radio aids to navigation in the VHF range	Line of sight	Radio remote control panel
LF Range Receiver BC453B	Reception of low frequency radio range signals	75 miles	Radio remote control panel
Glide Slope AN/ARN-18	Reception of signals for guidance during blind approach	15 miles	Radio remote control panel
Marker Beacon AN/ARN-12	Reception of marker signals	Vertical distance of airplane to ground	Radio remote control panel

24078-2

ANTENNA INSTALLATIONS



1. Glide Slope
2. VHF Communication
3. HF Communication
4. UHF Communication
5. Omnidirectional Range
6. Identification Set
7. Direction-Finding group
8. Marker Beacon
9. LF Range Receiver
10. Radio Compass Sense
11. Radio Compass Loop
12. TACAN

Figure 4-11

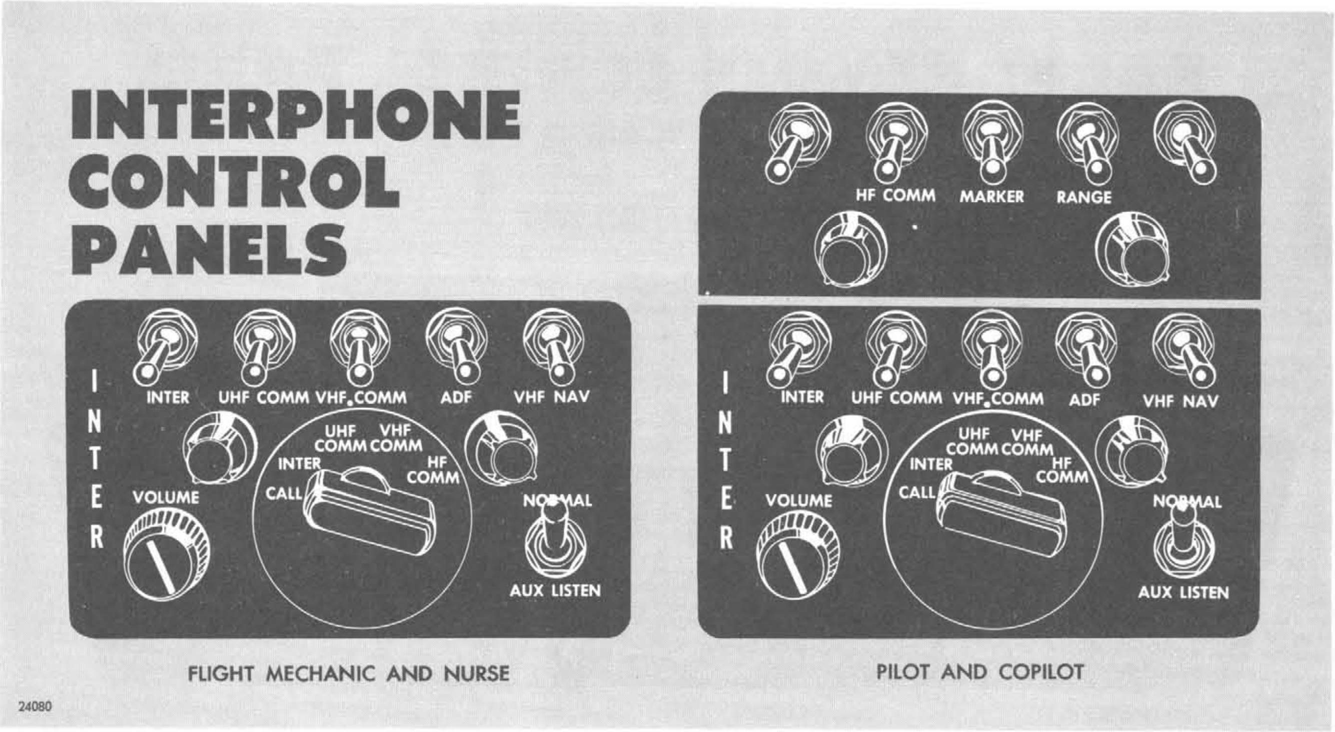


Figure 4-12

FLIGHT OPERATION COMMUNICATION AND NAVIGATION EQUIPMENT

INTERPHONE AN/AIC-10

Each crew station and the attendant's station is equipped with an interphone control panel (figure 4-12) and an outlet. In addition to the normal interphone channel (in use when the interphone selector switches are at INTER), to which all stations are connected, the system incorporates two specialized features. A CALL channel is connected to all stations so that any crew member or attendant can make contact with the other stations regardless of which channel the other stations have selected. One feature is a mixed facility which is provided at all stations. Each station may individually mix the audio signals of all the interphone and radio facilities provided at that particular station. This facility utilizes toggle switches located in the interphone control panels. Each station is provided, in whole or in part, with the following switches: "Inter" for the normal interphone channel; "HF Comm," "VHF Comm," and "UHF Comm" for the communication radios; "Marker" for the marker beacon; "Range" for the range receiver; "ADF" for the radio compass; and "VHF-NAV" for the omnidirectional range radio and its localizer function. The normal auxiliary listen toggle switch in the AUX LISTEN position bypasses the interphone amplifier in the event of amplifier failure. Two loudspeakers are installed in the flight compartment and one at the attendant's station as part of the interphone system. The other feature is a public address system for use by the pilots. A public address loudspeaker switch with positions LOUDSPEAKER, OFF, and STANDBY is located on the overhead radio remote control panels (figure 4-13). Ten loudspeakers for the system are installed in the main cabin. A public address switch on the attendant's radio control panel permits the attendant to use the system with the radio compass receiver for passenger entertainment. The pilot's radio compass controls override the attendant's station in the event the compass is required for navigation.

Operation of AN/AIC-10

Note

The interphone system is on whenever the airplane dc power supply system is energized.

Normal operation of the interphone:

1. Place all toggle switches on the control panels, except the normal auxiliary listen switch, in the OFF (down) position.
2. Turn the selector switch to the INTER position and speak into the microphone. The voice signal will be heard at all stations on the interphone channel.
3. To originate a call, hold the selector switch to CALL and speak into the microphone. All other stations will receive the signal regardless of the position of the selector switches on the other control panels.

Note

Normally the best audio level will be below the midposition of the volume control. Volume control past the midposition is used for radio reception during abnormal atmospheric conditions, interference, or weak signal strength.

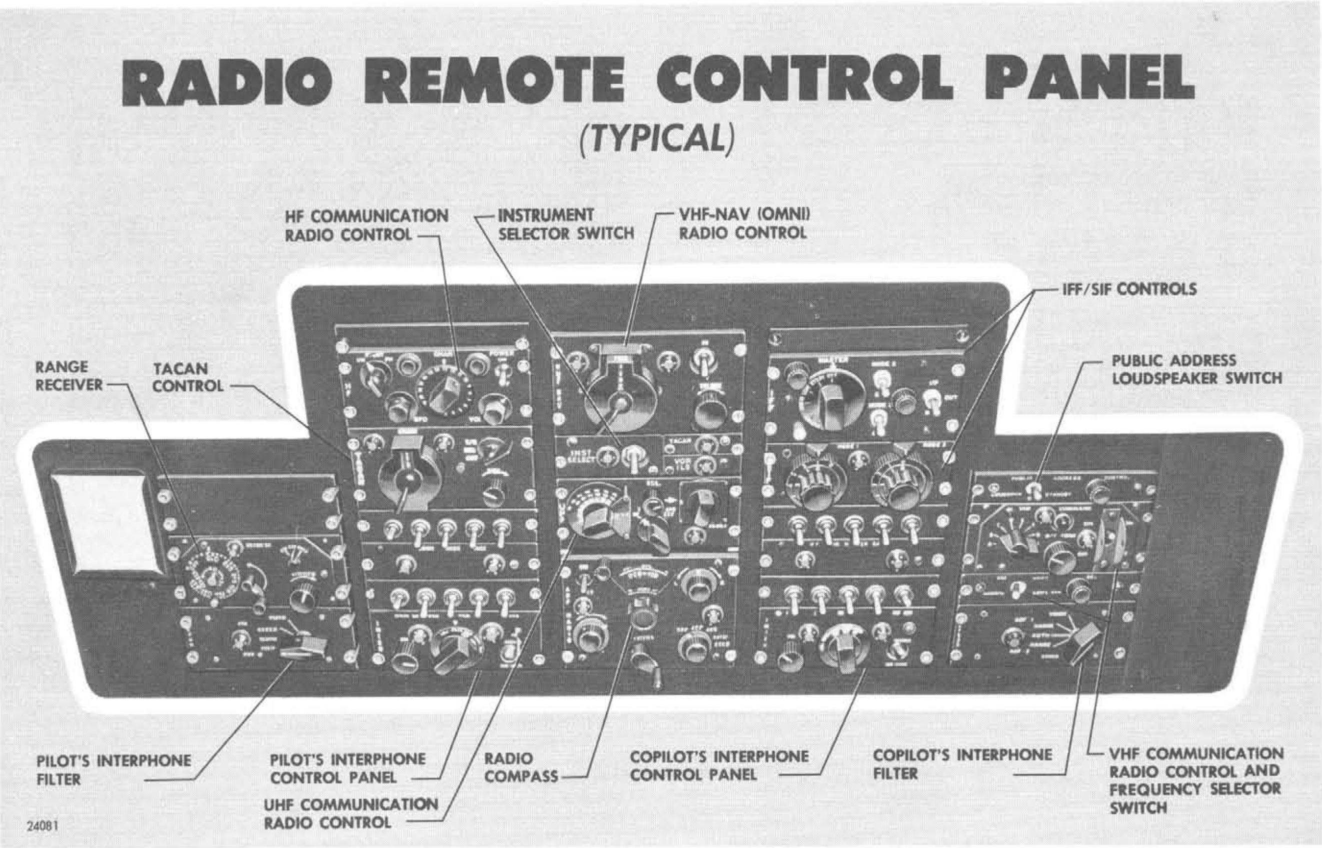

RADIO REMOTE CONTROL PANEL
(TYPICAL)
HF COMMUNICATION RADIO CONTROL
INSTRUMENT SELECTOR SWITCH
VHF-NAV (OMNI) RADIO CONTROL
IFF/SIF CONTROLS
RANGE RECEIVER
TACAN CONTROL
PUBLIC ADDRESS LOUDSPEAKER SWITCH
PILOT'S INTERPHONE FILTER
PILOT'S INTERPHONE CONTROL PANEL
UHF COMMUNICATION RADIO CONTROL
RADIO COMPASS
COPILOT'S INTERPHONE CONTROL PANEL
COPILOT'S INTERPHONE FILTER
VHF COMMUNICATION RADIO CONTROL AND FREQUENCY SELECTOR SWITCH
24081

Figure 4-13

Operation of the mixed signal facility:

1. Place the interphone selector switch on the control panel to any position except CALL.
2. Turn the mixing toggle switch to ON (up) one at a time. As each toggle switch is turned on, the audio signal from the facility associated with that toggle switch will be heard in the headset simultaneously with the previously selected signals.

In this manner it is possible to monitor eight different signals simultaneously, except where duplication exists between the toggle switches and the selector switch positions. Mixing can be accomplished in any position of the selector switch except CALL.

HF COMMUNICATION RADIO

This equipment consists of a Collins 18S4 transmitter-receiver which is remotely controlled through 20 preset channels in the frequency range of 2 mc to 18.5 mc. The control panel on the pilots' overhead radio panel (figure 4-13) provides all the operational functions necessary for voice communication.

Operation of HF Communication Radio

1. Place power switch to ON and allow time for units to warm up.
2. Turn function switch to PHONE position.
3. Turn channel selector switch to the desired frequency channel.
4. Push the microphone button to talk; release to listen.
5. To turn equipment off, place power switch to OFF.

VHF COMMUNICATION RADIO AN/ARC-36

This communication set is a very high frequency, multichannel receiver-transmitter, pretuned to operate on any one of 16 auto-tuning, crystal controlled channels. An individual remote control panel and a VHF command frequency selector switch are located on the pilots' overhead radio control panel. The VHF communication frequency selector switch has NORMAL and AUXILIARY positions. Each position provides eight channels that can be individually selected with the channel selector switch. A VHF communication radio channel is provided on each interphone control panel.

Operation of VHF Communication Radio AN/ARC-36

1. Place ON-OFF switch on the remote control panel to ON.
2. Place interphone selector switch to the VHF COMM position.

3. Select desired channel with the frequency selector switches.
4. Turn set off by moving ON-OFF switch to the OFF position.

UHF COMMUNICATION RADIO SET AN/ARC-27

The AN/ARC-27 transceiver provides voice communications in the UHF frequency range of 225.0 to 399.9 megacycles at line-of-sight distances. Transmission and reception is possible on any one of 1750 frequency channels, spaced 100 kilocycles apart, by manual selection on the main control panel located on the radio rack. The transceiver can be preset for automatic selection of 18 channels plus a guard channel. The channels are preset at the master control panel and may be automatically selected from either this master panel or the remote control panel on the overhead switch panel. On some airplanes, a quick manual tuner (figure 4-13) is installed on the radio remote control panel. On these airplanes, the pilot can select any one of the available 1750 frequency channels, including setting of preset channels, from the radio remote control panel. This equipment is also used to transmit a continuous signal, tone modulated at 1020 cycles per second, as an aid to direction finders or for emergency purposes.

Operation of UHF Communication Radio Set AN/ARC-27

Note

- Allow at least one minute for the set to warm up before operating, to preclude damage to the equipment.
- No transmission will be made on emergency (distress) frequency channels except for emergency purposes. This will prevent transmission of messages that could be construed as actual emergency messages.

To turn the equipment on, rotate the function switch to the desired type of operation.

SWITCH POSITION	FUNCTION
OFF	Transmitter-receiver and ADF off
T/R	Transmitter on in standby Main receiver on ADF in standby Guard receiver off
T/R & G REC	Transmitter on in standby Main receiver on Guard receiver on ADF in standby
ADF	Transmitter on in standby Guard receiver on in standby ADF and main receivers on

To turn the equipment off, rotate the function switch to OFF.

DIRECTION FINDER GROUP AN/ARA-25

The direction finder group, AN/ARA-25 provides a continuous visual indication of the relative direction of a radio station from the airplane. This equipment is used with the UHF communication set and is operated entirely from the UHF control panel. The continuous indication is given on the pilot's magnetic heading course indicators (15, 45, figure 1-7).

Operation of Direction Finding Group AN/ARA-25

When the UHF communication set AN/ARC-27 function switch is in the T/R or T/R & G REC position, the direction finding equipment is on in a standby condition. For complete operation, turn the UHF communication function switch to the ADF position. To turn the equipment entirely off, place the UHF communication function switch in the OFF position.

TACAN — AN/ARN-21 (Some Airplanes)

This set is designed to operate in conjunction with a radio navigation system called TACAN (TACtical Air Navigation). The system enables an equipped airplane to obtain continuous indications of its distance and bearing from any selected TACAN surface beacon located within a line-of-sight distance of approximately 195 nautical miles. The AN/ARN-21 utilizes the radio magnetic indicator, a range indicator, the deviation CDI of the course indicator, a control panel, and an instrument selector panel. The system operates on the following UHF frequency ranges: transmitter — 1025 to 1150 megacycles; receiver — 962 to 1024 megacycles and 1151 to 1213 megacycles. There are 126 frequency channels, any one of which may be selected by setting the proper controls on the control panel. The equipment is powered from the 28-volt dc nonessential bus and the 115-volt regulated and unregulated ac power supply.

Note

Successful operation of the AN/ARN-21 is dependent on the availability of TACAN surface beacons. On airplanes with this equipment, care should be exercised not to plan flights where compatible ground stations are not operable.

TACAN Control Panel

The TACAN control panel on the radio remote control panel (figure 4-13) has a power switch with OFF, REC and T/R positions, two channel selector knobs, a channel window, and a volume-control knob. With the power switch in the REC position, the distance function of the set is disabled, and only bearing information is available. With the power switch in the T/R position, both bearing and distance information is displayed on the indicators.

The left channel selector knob selects the first two figures of the TACAN beacon channel number, and the right channel selector knob selects the third number. The volume control knob is used to adjust the volume of aural identification signals received from the TACAN surface beacon.

Note

> The TACAN surface beacon channels range from 00 to 129; however, the AN/ARN-21 is designed to operate only on channels 01 to 126.

Instrument Selector Panel

An instrument selector panel containing a two-position instrument selector switch is located on the radio remote control panel (figure 4-13). The switch controls the CDI of the course indicator. With the switch in TACAN position, the panel area placarded "TACAN" is illuminated and the CDI responds to AN/ARN-21 functions. With the switch in the VOR/ILS position, the panel area placarded "VOR/ILS" is illuminated and the CDI responds to localizer signals used in conjunction with the AN/ARN-14 during an instrument landing system approach.

WARNING

> Due to automatic changeover features incorporated in the system, electrical power failure to the instrument selector switch relays will cause the course indicator to revert to TACAN indications while the instrument selector switch is in the VOR/ILS position. When operating VOR/ILS equipment with the instrument selector switch in the VOR/ILS position, the TACAN switch should be in the OFF position.

Radio Magnetic Indicator

The radio magnetic indicator (15, 45, figure 1-7) is also used with AN/ARN-21 (TACAN) as well as with the AN/ARN-6 and AN/ARN-14. It consists of a rotating compass card, actuated by the directional indicator (slaved) system, and two bearing indicators. The bearing indicators are connected to function as a single unit and are actuated by the receiver portion of the AN/ARN-21 when TACAN is selected. Azimuth signals from the TACAN surface beacon are then received by the AN/ARN-21 and relayed to the radio magnetic indicator, which indicates the magnetic bearing of the TACAN surface beacon. With the control switch in the REC position, bearing information may be received even though the transmitter portion of the set is not energized. The set is so designed that when the correct bearing information cannot be determined or the equipment is not functioning satisfactorily, the indicator will "search" or rotate rapidly so the pilot will be unable to derive unreliable information from the azimuth indicator.

TACAN Range Indicator

The TACAN range indicator (13, figure 1-7) displays the distance in nautical miles between the airplane and the TACAN surface beacon. The numerals in the window are controlled by the range circuits of the AN/ARN-21. While the indicator is "searching" for the correct range or when the switch is in the REC position, the rotating numbers are partially covered by a red warning "OFF" bar, which warns against reading incorrect distance indications.

Course Indicator

Signals received by the AN/ARN-21 from the surface beacon are relayed to the CDI of the course indicator (1, figure 1-7). Deviation of the airplane course either to left or right of the transmitting beacon will be indicated by displacement of the CDI. For further information concerning course indicator refer to AN/ARN-14, this Section.

Operation of the AN/ARN-21

1. Power switch to either REC or T/R.
2. Instrument selector switch to TACAN.
3. Allow approximately 90 seconds warmup time after power is applied to nonessential buses. There is no delay when going from REC to T/R.
4. Select desired beacon channel.
5. Adjust volume to desired level.
6. To turn equipment off, position power switch to OFF.

OMNIDIRECTIONAL RANGE RADIO AN/ARN-14

This radio receiving set equips the airplane with very high frequency radio aids to navigation. The receiver, dynamotor, and indicator-control are installed on a rack in the tail section of the fuselage. The set is controlled from the radio remote control panel (figure 4-13). The following table lists the types of service provided by the omnirange radio, with their frequency bands:

FREQUENCY BAND IN MEGACYCLES	TYPE OF SERVICE
Odd tenth megacycles 108.1 thru 111.9	Runway localizer
Even tenth megacycles 108.0 thru 111.8 plus all frequencies between 112.0 and 117.9	Range (omnidirectional)
108.3 to 110.3	VHF two-course range
118.0 to 121.9	Tower
122.0 to 135.9	General communication

The equipment has 280 crystal-controlled communication-navigation reception channels, spaced 100 kilocycles apart in the range of 108.0 through 135.9 megacycles. Selector knobs, volume control, and a two-position ON-OFF switch are provided on a control panel on the overhead radio control panel. A pilot's course indicator and two radio magnetic indicators (RMI) are mounted on the flight instrument panels. Omnirange bearing information is indicated by the No. 2 RMI indicator.

Operation of Omnidirectional Range Radio AN/ARN-14

Turn the omnirange receiver on by placing the ON-OFF switch in the ON position. Select the frequency of the desired range station by rotating the two frequency selector knobs until the frequency appears in the window. Turn on the interphone VHF-NAV mixing switch and adjust the volume to the desired level. Course selection is made by turning the set knob, located on the face of the pilot's course indicator, until the desired course figures appear in the window on the course indicator. The CDI on the course indicator will swing to give an on-course or an off-course reading. The "TO-FROM" indicator shows the relative positions between the airplane and the range station. To turn the omnirange receiver off, place the ON-OFF switch in the OFF position.

GLIDE-SLOPE RADIO AN/ARN-18

This set is used in conjunction with the localizer portion of the omnidirectional range radio. Visual glide-slope indications are presented on the omnirange radio pilots' course indicator (1, figure 1-7). The glide-slope receiver is controlled from the omnirange control panel.

Operation of Glide-Slope Radio AN/ARN-18

1. Place the ON-OFF switch on the omnirange control panel in the ON position.
2. Place the instrument selector switch to VOR/ILS.
3. Select the localizer and glide-slope frequency to be used with the omnirange radio.
4. Adjust omnirange radio volume control to the desired level.
5. Observe glide-slope flight characteristics as indicated by the glide-slope indicator of the omnirange radio pilots' course indicator.
6. To turn the set off, place the omnirange ON-OFF switch in OFF position.

MARKER BEACON RADIO AN/ARN-12

The marker beacon receiver is in continuous operation whenever dc power is supplied to the nonessential bus. The pilots' marker beacon indicator light (2, figure 1-7) is mounted in the upper right-hand corner of the omnirange pilots' course indicator. The copilot's marker beacon indicator light (46, figure 1-7) is mounted on the flight instrument panel.

Operation of Marker Beacon Radio AN/ARN-12

1. Turn the interphone panel marker mixing switch on.
2. To discontinue reception of marker signals, turn the interphone panel marker mixing switch off.

RADIO COMPASS AN/ARN-6

The output of the pilots' radio compass is coupled to the No. 1 indicator on the pilot's and copilot's radio magnetic indicator (15, 45, figure 1-7). These indicators are used to indicate radio compass station bearings, and the No. 2 indicators are used to indicate omnirange and TACAN radio station bearings. The pilots' radio compass remote control panel (figure 4-13) is mounted on the overhead switch panel.

Operation of Radio Compass AN/ARN-6

1. To turn the equipment on, place the function switch in the COMP, ANT, or LOOP position.
2. Place the interphone panel ADF switch on.
3. To turn the equipment off, place the function switch in the OFF position.

L F RANGE RECEIVER BC-453B

This radio receiving set provides an additional means of receiving low-frequency radio range signals in the range of 190 to 500 kilocycles. The controls are located on the pilots' radio remote control panel.

Operation of L F Range Receiver BC-453B

1. Turn set on by placing CW-OFF-MCW switch in CW or MCW position.
2. Place interphone panel range switch in the ON (up) position.
3. Select the desired frequency with the frequency selector switch and adjust to desired audio level.
4. To turn set off, place CW-OFF-MCW switch in the OFF position.

EMERGENCY RADIO TRANSMITTER AN/CRT-3

Stowage facilities are provided for an AN/CRT-3 emergency radio transmitter (figure 3-3). The transmitter can be used in flight, after an emergency landing, or after ditching to broadcast a distress signal (SOS) automatically on 500 KC and 8364 KC alternately. The transmitter may be used on 500 KC to broadcast keyed distress signals, position, or messages. The key may also be used to operate a signal light connected to the transmitter. The transmitter is fitted with a reel antenna. Two balloons and a hydrogen generator are provided in separate metal containers.

Note

No transmission will be made on emergency (distress) frequency channels except for emergency purposes. For test, demonstration, or drill purposes, the radio equipment will be operated in a shielded room to prevent transmission of messages that could be construed as actual emergency messages.

Operation of Emergency Radio Transmitter AN/CRT-3

CAUTION

Attach the antenna to the balloon before detaching the balloon from the hydrogen generator, to preclude loss of the balloon.

After the antenna has been raised to its full length, connect the antenna input wire to the antenna. Remove the black plastic cover from the ground connection and let the cover and attached ground wire trail in the water or bury the end of the ground wire in moist soil.

Note

Do not clip the antenna input wire to the ground wire. To do so will prevent signal output.

A kite is provided for use in place of the balloon to raise the antenna. Use of the kite is not recommended unless a steady 7- to 40-knot wind is blowing. The transmitter has a selector switch with three positions. Upper position is 500 KC MANUAL – USE KEY; center position is 500 KC – 8364 KC AUTOMATIC; bottom position is SIGNAL LIGHT – USE KEY. One indicator light on the top of the transmitter lights when the transmitter crank is being turned fast enough to generate transmission power. Another light on the top of the instrument duplicates the signal by lighting as each signal is transmitted. Optimum time for operation of the transmitter is from 15 to 18 minutes after the hour and 45 to 48 minutes after the hour when stations are required to monitor 500 KC. Continued operation for ten minutes after each period assists rescue efforts by giving time to get cross-bearings on your position. Effective range is over 200 miles in daytime on 500 KC and up to 1500 miles on 8364 KC. At night the ranges increase to 500 miles and 2000 miles respectively.

EMERGENCY TRANSMITTER-RECEIVER AN/URC-4

The emergency receiver-transmitter AN/URC-4 is a portable hand operated unit designed to furnish two-way VHF and UHF voice and keyed tone communication between distressed personnel and searching aircraft. The equipment is normally preset to the distress frequencies of 121.5 and 243 megacycles. The actual frequencies of operation are indicated on the nameplate of the receiver-transmitter unit. It is mandatory that the battery and the receiver-transmitter be secured in the carrier vest. The 125-volt dc battery has a life of approximately 24 hours continuous operation in cycles of five minutes transmitting and five minutes receiving. The battery life is considerably extended if the equipment is shut down between operating periods, or if the receiver periods are longer than the transmitting periods.

Operation of Transmitter-Receiver AN/URC-4

1. Remove only the receiver-transmitter unit from the vest pocket.
2. Extend the antenna.

Note

When VHF receiving and transmission is desired, the horizontal arms should be extended to their greatest length. When UHF operation is desired, the horizontal arms should be pushed inward so the horizontal length is at a minimum.

3. Place the band switch on the desired operating frequency (VHF or UHF) as shown on the nameplate.
4. Place the lock-unlock control in the UNLOCK position.
5. Hold the unit so that the mike-earphone aperture is approximately four inches from the lips or ear, dependent on whether the operator is to transmit or receive.
6. Press the trans, rec, or tone button for the desired function.

Note

- The tone pushbutton is used for keying the transmitter with a telegraph code or employing a continuous tone signal. It functions only when the transmitting pushbutton is held in.
- To prevent grounding the set during operation, keep fingers off of the antenna.

RADAR IDENTIFICATION SET AN/APX-25

The radar identification set (IFF-SIF) enables the airplane to identify itself automatically whenever it is challenged by proper signals from radar recognition equipment at land bases, aboard ships, or in other airplanes. The IFF/SIF controls are mounted on the radio remote control panel. The equipment operates on 28-volt dc power from the essential bus and 115-volt ac power from the No. 1 alternator bus.

Operation of Radar Identification Set AN/APX-25

1. To turn the equipment on, rotate the master control knob to one of the operating positions as required by tactical instructions for the mission.
2. Position the mode selector switches as required by tactical instructions.
3. To turn the equipment off, rotate the master control knob to the OFF position.

LIGHTING EQUIPMENT

The lighting circuits are protected by trip-free circuit breakers. Circuit breakers that protect flight compartment, interior, and exterior lights are located on the main circuit breaker panel behind the copilot's seat. Those which protect passenger compartment lights that are nonessential are located on the auxiliary circuit breaker panel behind the pilot's seat. All lights are dc powered.

EXTERIOR LIGHTS

Position Lights

One white light and one yellow light are located on the aft fuselage tip; four white lights, two each on top and bottom, are centrally located on the fuselage; red and green lights are located on the left and right wing tips, respectively. Two circuit breakers protect this circuit. Two switches located on the copilot's console control the position lights. The position lights' bright-dim switch (27, figure 1-6) controls intensity of the lights. The position lights' steady-flash switch (27, figure 1-6) has STEADY, FLASH, and OFF positions.

Landing Lights

Two landing lights are mounted flush on the forward lower surface of the wing, one outboard of each nacelle. Each light is lowered into position by an electrically operated motor, and is turned on automatically when fully extended and turned off automatically as soon as retraction starts. Refer to Section V for landing light extension speed limitations. Four circuit breakers protect the landing light motor and landing light circuits. Two landing light switches (figure 1-9) are mounted on the overhead switch panel. Each switch controls the motor and lights of its corresponding left or right landing light. Switch positions are EXTEND, ON, OFF, and RETRACT.

Taxi Light

The taxi light is located on the nose landing gear strut. The taxi light switch (figure 1-9) is mounted on the overhead switch panel next to the landing light switches. It has ON and OFF positions. The taxi light circuit breaker protects this system.

Passing Light

The passing light is mounted flush with the fuselage skin on the nose of the airplane. The passing light switch (4, figure 1-6) is located on the copilot's console. It has ON and OFF positions. The passing and leading edge lights circuit breaker protects the circuit.

Wheel Well and Nose Compartment Lights

Lights are provided in the nose and main landing gear wells to afford means of checking the nose gear downlatch and viewing the position of the main landing gear during night landing operations. One light is located in each of the main wheel wells, and two are located in the nose wheel well. The wheel well light circuit breaker protects the circuit. One switch (28, figure 1-6), located on the copilot's console, controls all wheel well and nose compartment lights. It has ON and OFF positions.

Wing Leading Edge Inspection Lights

Two wing leading edge inspection lights are mounted flush with the skin on the outboard side of each engine nacelle. Their primary purpose is to provide light for inspecting the wings for icing accumulations. The passing and leading edge lights circuit breaker protects the circuit. The two lights are controlled by a switch (6, figure 1-6) located on the copilot's console.

Anticollision Light

A red rotating anticollision light is located on top of the vertical stabilizer and is protected by a circuit breaker located at the main circuit breaker panel. A two-position ON-OFF switch is located on the copilot's console (29, figure 1-6).

Note

> The rotating anticollision light should be turned OFF during flight through conditions of reduced visibility where the pilot could experience vertigo as a result of the rotating reflections of the light against the clouds. In addition, the light would be ineffective as an anticollision light during instrument conditions since it could not be observed by pilots of other airplanes.

INTERIOR LIGHTS

Instrument Panel Lights

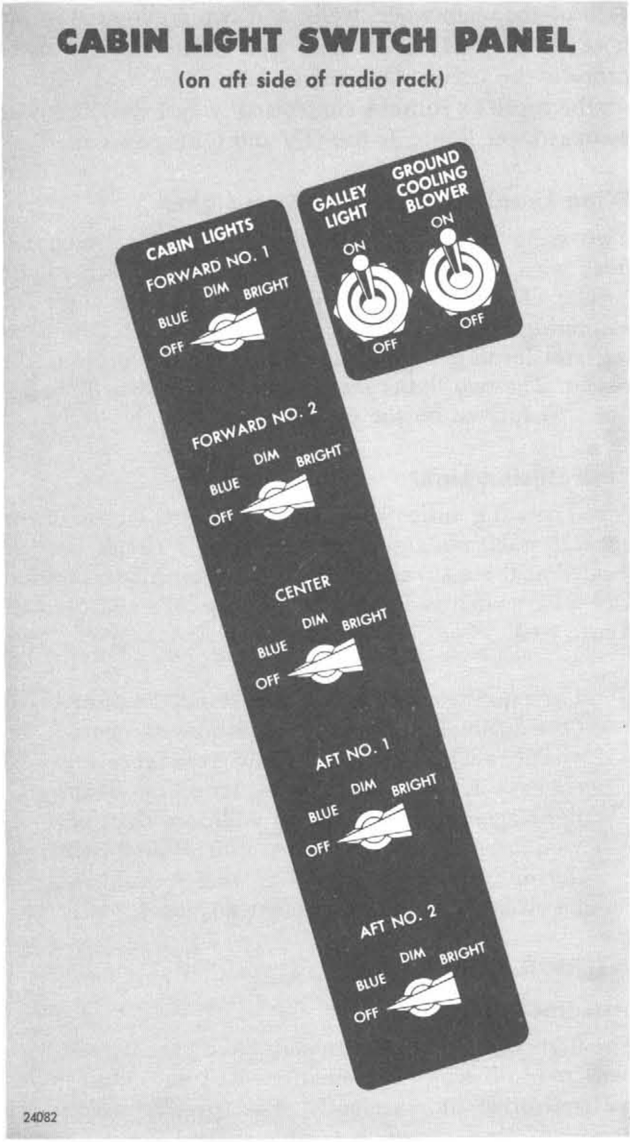
The flight and engine instrument panels are lighted with both red and white illumination. Red and white lights are controlled independently. Two circuit breakers are provided. Two rheostats (7, figure 1-5) on the pilot's console and two rheostats (3, figure 1-6) on the copilot's console control the lights. The red lights are powered by the dc emergency bus and the white lights are powered by the dc main bus.

Overhead Switch Panel Lights

The overhead switch panel and the radio remote control panels (including pilot's and copilot's interphone panels) are back lighted. The overhead switch panel light circuit breaker protects the circuit. The overhead switch panel light rheostat (figure 1-9) is located on the overhead switch panel. It is at OFF when fully counterclockwise, and turns clockwise to BRIGHT position.

Compass Light

This light illuminates the standby magnetic compass, and is located at the compass. It is protected by the overhead switch panel light circuit breaker. The light is controlled by the magnetic compass light rheostat on the overhead switch panel (figure 1-9).



CABIN LIGHT SWITCH PANEL

(on aft side of radio rack)

Figure 4-14

Console Lights

The pilot's and copilot's consoles are separately illuminated with three lights each (2, figure 1-5, and 8, figure 1-6), mounted above the console. The instrument panel white lights circuit breaker protects the circuit. The lights are independently controlled by two rheostats (4, figure 1-5, 8, figure 1-6). Both rheostats are located directly above their respective consoles, and are off in the counterclockwise direction and on in the clockwise direction.

Flight Compartment Dome Floodlight

The dome floodlight is located in the pilot's dome light switch panel (figure 1-4) on the ceiling of the flight compartment. Both red and white illumination are provided by this floodlight. Two dome light circuit breakers protect the circuit. Two rheostats on the pilot's dome light switch panel are provided for red and white illumination. The white light can also be turned on by depressing either of the control wheel dome light buttons.

Pedestal Lights

Two lights which spot the pedestal are mounted in the pilot's dome light switch panel (figure 1-4). Both red and white illumination are provided. Two dome lights circuit breakers protect the circuit. Two rheostats on the pilot's dome light switch panel are provided for red and white illumination.

Pilots' Map Reading Lights

Pilot's and copilot's map reading lights are located in the pilot's dome light switch panel (figure 1-4). Only white illumination is provided, but each light has a red filter which can be turned into position by means of an adjacent knob. The lights are protected by the white dome light circuit breaker. Separate rheostats on the pilot's dome light switch panel are provided for the pilot's and copilot's map reading lights.

Fuel Control Panel Light

This red light works in conjunction with, and is operated simultaneously with, the flight compartment dome red floodlight. It is protected by the red dome light circuit breaker. The rheostat on the pilot's dome light switch panel controls the fuel control panel light.

Hydraulic Reservoir Light

This light is located at the hydraulic reservoir sight gage. Its circuit is protected by the instrument panel white lights circuit breaker. The switch is mounted on the reservoir cover above the sight gage. It has ON and OFF positions.

Entrance Door and Stair Lights

Three lights illuminate entry to the airplane—one on the bottom step riser, one on the entrance door frame and one on the stairway canopy. The entrance door light circuit breaker protects this circuit. These lights function automatically with relation to the open or closed position of the entrance door. Whenever the door is opened and the stair is down, the lights will be on. They will be out when the stair is folded and the door is closed.

Cabin Ceiling Lights

Eleven dome lights are mounted along the cabin ceiling. Cabin lights circuit breakers protect the circuits. The lights are controlled by five switches (figure 4-14) on the cabin light switch panel located on the aft side of the radio rack. These switches provide sectional lighting of the cabin with white or blue lights.

Lavatory Lights

A light is mounted on the ceiling in each lavatory compartment. The cabin lights circuit breaker protects this circuit. The switches are mounted on the wall just inside the doorway of each compartment.

Passenger Reading Lights

Individual reading spotlights are mounted over the outboard seats at each passenger seat location except the rearmost two seats on the left side. Two lights at each station are separately controlled by an ON-OFF switch adjacent to the light. The circuit breakers are on the auxiliary circuit breaker panel.

Attendant's Utility Lights and Receptacles

Two utility lights with drop cords are provided for use by the attendant. A power receptacle for these lights is located adjacent to the cabin ceiling light at each litter station. The cabin white light circuit breaker protects these lights.

Aldis Lamp Receptacle

An Aldis lamp receptacle is located on the lower half of the main circuit breaker panel. Power is supplied from the main dc bus. A circuit breaker is located to the left of the receptacle.

Litter Door Light

This light is located on the litter door and functions automatically with the opening and closing of the door. The litter door light circuit breaker is on the main circuit breaker panel.

Baggage Compartment Light

This light is mounted in the ceiling of the aft baggage compartment and is controlled from the cabin lights circuit by an ON-OFF switch located on the light.

Warning Sign

An illuminated "FASTEN SEAT BELTS – NO SMOKING" sign is installed on the forward side of the lavatory compartment. Two switches on the pilot's console operate the signs. A warning sign circuit breaker on the main panel protects this circuit.

Interphone Panel Lights

All crew and attendant interphone panels are edge-lighted. The lights are protected by circuit breakers on the main circuit breaker panel. The interphone panel lights at the crew chief's and attendant's stations are individually controlled by rheostats mounted on each control panel.

Spare Lamp Bulbs

Stowage for 18 spare lamp bulbs is provided in the copilot's console.

OXYGEN SYSTEM

A gaseous, demand type oxygen system, supplied by one type G-1 oxygen cylinder, is installed in the airplane. The cylinder is located below the floor forward of the wing. The complete oxygen system, including the portable oxygen units, may be filled at a filler valve accessible through a hinged door on the right side of the fuselage forward of the wing. The system provides outlets for the pilot, copilot, and crew chief.

Oxygen Pressure Gages

Pressure gages are located on the pilot's console and the copilot's console. Normal oxygen system pressure after servicing is 400-450 psi, corrected for temperature.

Oxygen Regulators

A diluter-demand oxygen regulator is installed at each crew station. The pilot's regulator (15, figure 1-5) is under the pilot's console. The copilot's regulator (21, figure 1-6) is under the copilot's console. The crew chief's regulator is on the crew chief's oxygen panel. Each regulator automatically supplies the required mixture of air and oxygen at all altitudes. A diluter lever and an emergency knob are provided on each regulator.

Oxygen Regulator Diluter Levers

A diluter lever is provided on each oxygen regulator. The lever has two positions, NORMAL OXYGEN and 100% OXYGEN. With the lever in the NORMAL OXYGEN position, the regulator automatically supplies the proper mixture of air and oxygen to the mask at all altitudes. With the lever in 100% OXYGEN position, the regulator supplies 100% oxygen to the mask for emergency use.

Oxygen Regulator Emergency Knobs

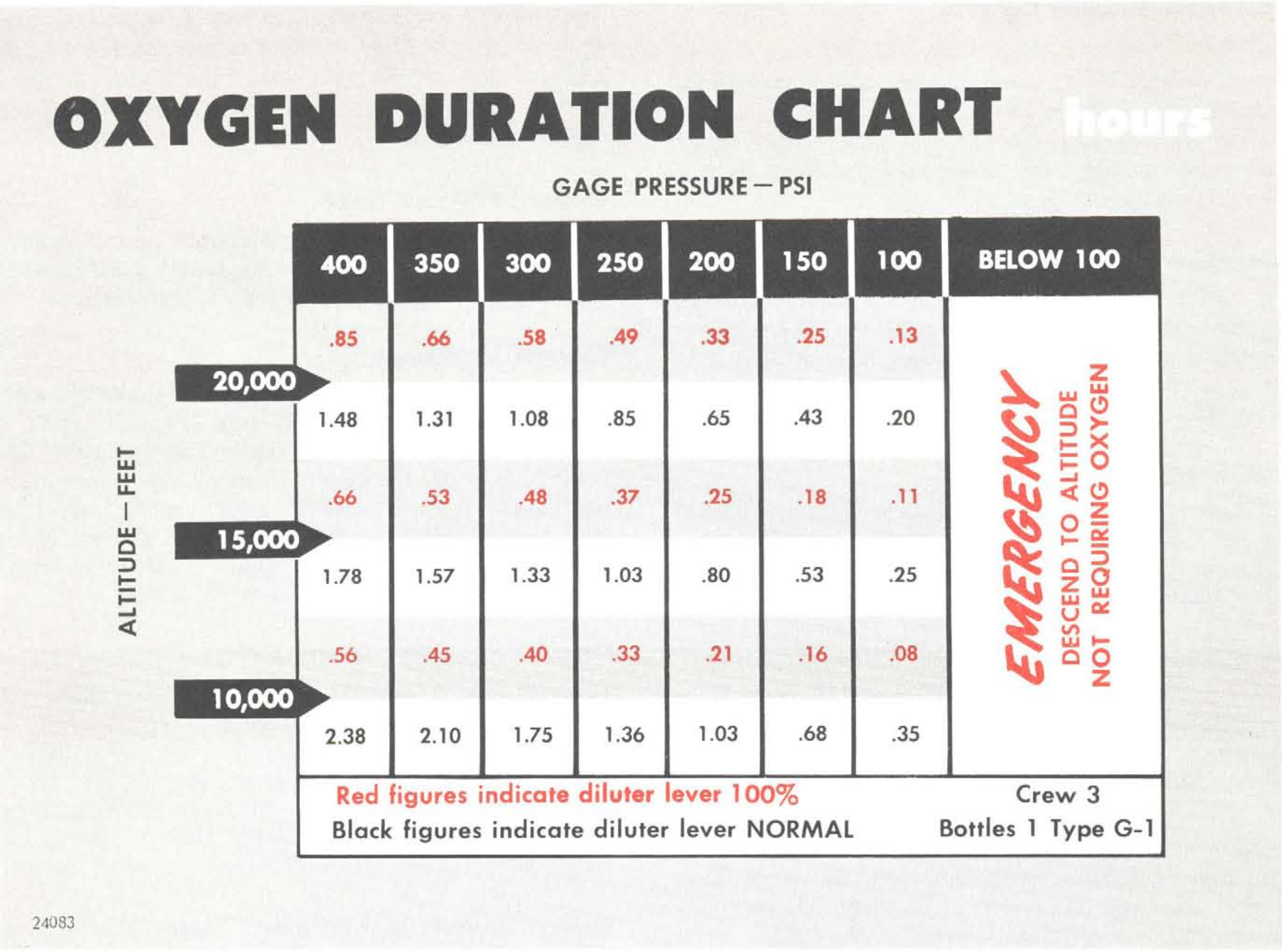
A red emergency knob is provided on each regulator, and is safety-wired off in full clockwise position. This knob controls the regulator emergency valve which, when opened, provides a continuous stream of 100% oxygen to the mask. The valve is opened by breaking the safety wire and turning the knob counterclockwise as indicated by an arrow marked on the knob. This knob is used only when the regulator is inoperative.

Oxygen Flow Indicators

Separate oxygen flow indicators are provided for each crew station. The pilot's and copilot's indicators are located on their respective consoles. The crew chief's indicator is on the crew chief's oxygen panel. The indicator is fitted with an eye-shaped shutter which "winks" with each breath if oxygen is being delivered by the regulator.

Portable Oxygen Units

Four gaseous portable oxygen units are provided. Two demand units are located in the flight compartment directly behind the pilot's seat. Two continuous flow units are stowed in the lower section of the crew locker. The portable oxygen units should be connected to the recharge valve in the airplane while the oxygen system is being recharged.



OXYGEN DURATION CHART hours

GAGE PRESSURE — PSI

ALTITUDE — FEET	400	350	300	250	200	150	100	BELOW 100
20,000	.85	.66	.58	.49	.33	.25	.13	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	1.48	1.31	1.08	.85	.65	.43	.20	
15,000	.66	.53	.48	.37	.25	.18	.11	
	1.78	1.57	1.33	1.03	.80	.53	.25	
10,000	.56	.45	.40	.33	.21	.16	.08	
	2.38	2.10	1.75	1.36	1.03	.68	.35	

Red figures indicate diluter lever 100%

Black figures indicate diluter lever NORMAL

Crew 3

Bottles 1 Type G-1

24083

Figure 4-15

Portable Oxygen Unit Recharger

A portable oxygen unit recharger is provided aft of the flight compartment in the crew locker.

NORMAL OPERATION OF OXYGEN SYSTEM

Set the regulator diluter lever at the NORMAL OXYGEN position. The regulator emergency knob should remain safety-wired in the full clockwise position. When using a portable oxygen unit, recharge the unit before its pressure falls below 50 psi.

Note

Each crew member should check his oxygen regulator with the diluter valve first at the NORMAL OXYGEN position and then at the 100% OXYGEN position as follows: Remove mask and blow gently into end of the oxygen regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or no resistance to blowing indicates a faulty demand diaphragm or diluter air valve or a leak in the hose.

EMERGENCY OPERATION OF OXYGEN SYSTEM

With the symptoms of the onset of hypoxia or if smoke or fuel fumes should enter the cabin, set the regulator diluter lever to the 100% OXYGEN position. If the oxygen regulator becomes inoperative, open the emergency valve by turning the red emergency knob counterclockwise.

CAUTION

When use of the 100% OXYGEN position of the regulator diluter lever or use of the emergency knob becomes necessary, the pilot will be informed of this action. Use of this equipment in this manner rapidly reduces the oxygen supply duration. After the emergency, return the controls to their normal position and notify the pilot.

AUTOMATIC PILOT

The airplane is equipped with an all-electric, type E-4 automatic pilot system. Control of the system is exercised from the autopilot controller unit located on the pilot's pedestal. Automatic approach equipment is coupled with the autopilot system (refer to AUTOMATIC APPROACH EQUIPMENT, this Section). Release and interlock circuits operate automatically to prevent or stop operation of the system in the event of electrical system malfunction. Both 28-volt dc and 115-volt regulated ac are used in the operation of the autopilot system.

Autopilot Filament Circuit Breaker Switch

A circuit breaker switch with ON and OFF positions is located on the nonessential bus circuit breaker panel. When the switch is placed in the ON position, dc power from the nonessential bus is supplied to the autopilot filaments and to the spare inverter which supplies 115-volt ac power to the autopilot, if the inverter selector switch is in the MAIN or OFF position. Should the inverter selector switch be placed in the SPARE position, the autopilot and the C-1 amplifier are automatically disconnected and the spare inverter then obtains power from the emergency dc bus and supplies power for the flight and engine instruments. See figure 1-25.

Power (Pilot) Switch

This ON-OFF switch (22, figure 1-12), when placed in the ON position, applies power to the autopilot control circuits and units. The power switch cannot be moved to the ON position under any of the following conditions:

1. Autopilot circuit breakers are tripped.
2. Regulated ac power supply is less than 90 volts.
3. Power has been supplied for less than two minutes.
4. Either release button (on control wheels) is depressed.
5. Turn knob is not in its detent.
6. Engage and release levers are in ON position.
7. Automatic approach selector switch is not in AUTOMATIC PILOT position.

The power switch will return to the OFF position under the following conditions:

1. Regulated ac power drops to 75 volts.
2. Either release button (on control wheels) is depressed.

Note

If the power switch trips to the OFF position for either reason given above, it cannot be reset in the ON position if any of the conditions previously listed exists.

3. Autopilot controls are improperly operated.

Figure 4-16

Engage and Release Levers

Three levers (3, figure 1-11) on the quadrant section of the pedestal are provided for mechanically engaging and releasing the aileron, elevator, and rudder control units of the autopilot system. The levers are individually marked A, E, and R. The positions placarded on the quadrant are ON (aft) and OFF (forward). The levers can be positioned together or individually.

Release Buttons

An autopilot release switch button (9, figure 1-5, 2, figure 1-6) is mounted in the outboard tip of each control wheel. The release buttons are provided so that either pilot can instantly release the autopilot and take over manual control of the airplane, without moving his hands from the control wheel. When either release button is depressed, the primary power circuit to the pedestal controller unit is broken and the power switch returns to the OFF position.

Turn and Trim Knobs

A turn knob (4, figure 1-12) on the top of the controller unit has a detent at its centered position for flight at a constant heading. Rotating the knob to the left or right of its center position results in a coordinated, banked turn in the desired direction. Pitch trim knobs (7, 24, figure 1-12) are mounted on each side of the autopilot controller. Placards on the controller unit, marked "Glide" and "Climb," indicate the direction that the pitch trim knobs should be turned to obtain climb or descent. An aileron trim knob (6, figure 1-12), on the aft face of the controller unit, is normally used for wings-level flight after autopilot engagement. Banked turns are usually accomplished with the turn knob.

Note

Continuous automatic alignment of the signal system with the attitude of the airplane on all three axes is provided whenever the autopilot is not engaged. With the power (pilot) switch on, operation of the aileron trim knob will only shift the point at which synchronization occurs in the autopilot system without aligning the trim indicator. The purpose of the trim knob is to trim the roll axis for wings-level flight after the autopilot is engaged.

Altitude Control Switch

The altitude control switch (8, figure 1-12), on the aft face of the autopilot controller unit, automatically maintains the airplane at the pressure altitude at which it is flying at the moment the switch is turned on.

Compass Slaving Switch

A compass slaving switch (22, figure 1-4), on the bulkhead behind the pilot, has positions IN and OUT. Normally the switch is left in the IN position. With the autopilot power switch ON and the slaving switch OUT, the autopilot continues to steer the airplane but the gyro indicator is not affected by signals from the remote compass transmitter. The gyro indicator will precess and autopilot course will respond to the precession. If the autopilot power switch is OFF and the slaving switch is OUT, the indicator will act independently as a directional gyro. The compass slaving switch is provided primarily for use in the polar regions where compass operation is erratic and it is desired to deslave the gyro compass system from the remote magnetic compass transmitter.

CAUTION

The compass slaving switch must not be cycled more than once in any ten-minute period to prevent possible damage to gyros as the result of repeated fast erection cycles.

Trim Indicator

A trim indicator unit (figure 4-16) on the autopilot controller provides visual indication of the signal system in three axes of movement. Alignment of the index lines is an indication of airplane trim. If a signal is constantly being produced to maintain the desired airplane attitude, the corresponding index line will show the magnitude of the signal (out of trim).

Autopilot Off Indicator Light

An amber indicator light (10, figure 1-12), placarded "Autopilot OFF," is located on the pedestal below the autopilot controller unit. The light operates as a warning when the power supply to the autopilot system is interrupted and the engaging levers are still in the ON position.

NORMAL OPERATION OF AUTOMATIC PILOT

On Entering the Airplane

1. Power switch — OFF.
2. Engaging levers — Check OFF.
3. Flight controls — Check for freedom of movement.
4. Automatic approach selector switch — AUTOPILOT.

Ground Test

1. Check the freedom of all controls from one extreme control position to the other, and turn on airplane regulated ac power and the localizer and glideslope receivers.
2. Check the ac voltmeter. Regulated voltage should read 115 (±2.5) volts. Check the dc voltmeter. It should read 28 (±0.5) volts. These voltages must not vary or hunt; if they do, erratic autopilot operation will result.

3. Wait for the directional indicator gyro to level and orient to magnetic north. During this time (two minutes) the autopilot power switch remains locked in OFF position.
4. Turn power switch to ON.
5. Check the trim meters on the autopilot controller. The meter needles should be approximately centered and stationary. If one or more of the meters indicates a full scale deflection, do not engage the autopilot until the cause of the deflection has been corrected.
6. Check to see that the approach localizer ready light above the selector switch is operating.
7. Check the directional indicators (slaved) and make sure they indicate the proper magnetic heading.

Note

The control column counterbalance weight will prevent the autopilot from assuming full elevator control in a ground test. During the tests, hold the control column back to neutral and rest the feet on the rudder pedals. When a tendency to move in the correct direction in response to test is noted, proceed to the next test step. Accomplish the checks as rapidly as possible in order to avoid excessive loads on the autopilot control system.

8. With controls neutral, move the autopilot engage levers to the ON position.
9. Rotate the top of the pitch trim knob aft (nose up). The control column should tend to move aft.
10. Rotate the pitch trim knob forward (nose down). The control column should tend to move forward.
11. Rotate the aileron trim knob counterclockwise. The control wheel should rotate counterclockwise.
12. Rotate the aileron trim knob clockwise. The control wheel should rotate clockwise.
13. Move the turn knob on the top of the autopilot controller counterclockwise approximately 15°. The control wheel should start to rotate counterclockwise and the left rudder pedal should move forward slowly. Return the knob to detent. The control wheel should slowly return to neutral, but the rudder pedals will remain in the position in which they stopped.
14. Repeat step 13 for clockwise rotation.
15. Pull control column aft. The trim tab wheel should move for nose down trim.
16. Push control column forward. The trim tab wheel should move for nose up trim.
17. Check overpowering of trim tab servo by moving trim tab wheel against the servo motion in both directions.
18. Turn the altitude control switch on. The elevator trim meter will deflect upwards. Moving the control column aft will return the trim meter to center, where it will remain.
19. Pull the control column aft of neutral and hold against the servo force. As the elevator engaging lever is moved to disengage OFF position, the force required to hold the control column should suddenly decrease.
20. Rotate the aileron wheel left or right from neutral and hold against the servo force. As the aileron engaging lever is moved to the disengage OFF position, the force required to hold the wheel should suddenly decrease.
21. Push the rudder pedal left or right from neutral and hold against the servo force. As the rudder engaging lever is moved to the disengage OFF position, the force required to hold the pedal should suddenly decrease.
22. Push pilot's autopilot release button. The power and altitude control switches should snap automatically to OFF position and lock.
23. Manually check the controls to be sure that they are free.

During Flight

The autopilot can be engaged with complete safety during straight and level flight, normal climb, or normal descent. It should not be engaged when the airplane is turning. If the autopilot is engaged during climb or descent, the airplane will continue to fly in that attitude until the pitch control knobs are moved to change attitude. If a condition unfavorable to operation of the autopilot occurs, or if the controls are improperly operated, automatic release and interlock circuits cut the power supply to the system and the autopilot cannot again be operated until the proper conditions exist.

Engaging Procedure

Engage the autopilot as follows:

1. DC voltmeter and selector switch — Check for 28 volts on BUS position.
2. AC voltmeter and selector switch — Check for 115 volts in the MAIN INV and SPARE INV positions.
3. Trim airplane manually for hands-off flight.

CAUTION

If autopilot is turned on without trimming airplane for hands-off flight, unnecessary strains are imposed on the system.

4. Turn knob – Detent.
5. Automatic approach – AUTOMATIC PILOT.
6. Power switch – ON.
7. Engage levers – ON.
8. Aileron knob and pitch knobs – Adjust so that trim indicator is aligned.
9. Altitude control switch – On at desired altitude.

CAUTION

- If altitude control switch is turned to ON during climb or descent, airplane will immediately level out and hold altitude at which switch was turned on. When altitude control switch is turned to OFF, airplane will immediately return to flight attitude held when the switch was turned on.
- The copilot's selector valve on the flight instrument panel should not be moved while the altitude control switch is on. Changing the static selector valve setting while the altitude control switch is on will cause the airplane to change attitude very suddenly.

Climb and descent are effected by rotating the pitch trim knobs on the pedestal controller. The change in attitude will be proportional to the amount of knob rotation, and the airplane will remain in the new attitude as long as the knobs are displaced. Coordinated turns are made by rotating the turn knob on the pedestal controller. The resultant rate of turn will be proportional to the amount of turn knob deflection. The airplane will continue turning as long as the turn knob is displaced. Climbing turns or descending turns can be obtained by coordinated use of the turn knob and pitch trim knobs. Aileron trim can be altered by rotating the aileron trim knob on the controller. Automatic pitch trim control is obtained through the action of a servo motor on the elevator trim tab. When the altitude control is on, the pitch turn knobs are inoperative. On long flights over water or over terrain of known altitude, the "attitude" condition will be found the most satisfactory, from an economy of fuel consumption viewpoint. In this condition the autopilot will maintain the airplane in a level flight attitude and the altitude of the airplane will vary as thermal conditions change. In mountainous regions or in areas where ground altitude variations have not been accurately determined, the "altitude" condition is desirable. In the "altitude" condition (altitude switch at ON), the autopilot will be constantly changing the airplane pitch attitude, to compensate for loss or gain of altitude due to the thermal conditions. Control of the airplane's power setting will have to be exercised to maintain the airplane airspeed at the desired level for all attitude conditions encountered while flying in this manner. The "altitude" condition should not be used when icing conditions are encountered. The added weight of accumulated ice on the wings causes a reduction in airspeed and loss of altitude. If the altitude switch is on, the autopilot will attempt to hold altitude by increasing the up-elevator force, thereby further reducing the airspeed, increasing the tendency of ice to accumulate on the unheated surfaces of the wing and tail, and increasing the danger of a stall. In turbulent air the autopilot may be used; however, the altitude control switch must be off.

Releasing Procedure

There are three ways of turning off the autopilot. For temporary release, move engaging levers to OFF (forward), leaving power switch at ON. For permanent release, move engaging levers to OFF and turn power switch to OFF. For instantaneous release, press release button on either control wheel; the power switch will automatically move to OFF, and engaging levers can be moved to OFF later.

AUTOMATIC PILOT OPERATING LIMITATIONS

Refer to AUTOMATIC PILOT OPERATING LIMITATIONS, Section V.

EMERGENCY OPERATION OF AUTOMATIC PILOT

Engine Failure

In case of an engine failure while flying on autopilot, the autopilot will be rendered inoperative by the automatic load monitoring system. Autopilot will be shut off and dc power for the autopilot will be removed.

AUTOMATIC APPROACH EQUIPMENT

An automatic approach control unit, dc powered, modifies and amplifies signals received from the omnirange (localizer) and glide-slope receivers of the instrument landing system. These signals are then applied to the autopilot to automatically guide the airplane down the intersection of the localizer course, and glide-slope beams to the runway. The automatic approach equipment is flexible with regard to the geometry of the approach pattern.

Automatic Approach Selector Switch

This switch (2, figure 1-12) is located on the pilots' pedestal forward and to the left of the autopilot controller unit. The switch has three positions: AUTOMATIC PILOT, LOCALIZER, and APPROACH. The switch is left in the AUTOMATIC PILOT position at all times except during automatic approach. The LOCALIZER position is used in the approach to and alignment with the localizer course up to the point where the center of the glide-slope beam is intercepted. With the switch in the LOCALIZER position, turns are controlled by the localizer signals. The APPROACH position is used to hold the airplane in the approach glide during the final letdown along the glide-slope. When the switch is in the APPROACH position, the pitch attitude of the airplane is controlled by the glide-slope signals, and turns are controlled by the localizer signals.

Note

The autopilot system can be operated by either the autopilot controller unit or the automatic approach unit, but cannot be operated by both units at once. Moving the automatic approach selector switch out of AUTOMATIC PILOT position while operating the autopilot controller knobs, or moving an autopilot controller knob while the automatic approach selector switch is in LOCALIZER or APPROACH positions, will automatically turn the autopilot off and trip the power switch to OFF position.

Approach Ready Light

A green indicator light (1, figure 1-12) is located on the pedestal just forward of the automatic approach selector switch. When the automatic approach selector switch is moved out of the AUTOMATIC PILOT position while the power switch is on, this light illuminates to indicate that the automatic approach unit is receiving power. It should remain illuminated at all times during an automatic approach. If the light goes out during an automatic approach, it is an indication that power to the equipment has been interrupted and the power switch has tripped to the OFF position.

NORMAL OPERATION OF AUTOMATIC APPROACH EQUIPMENT

Refer to INSTRUMENT LOW APPROACHES, Section IX.

AUTOMATIC APPROACH EQUIPMENT OPERATING LIMITATIONS

Refer to AUTOMATIC APPROACH EQUIPMENT LIMITATIONS, Section V.

EMERGENCY OPERATION OF AUTOMATIC APPROACH EQUIPMENT

There are no provisions for emergency operation of the automatic approach equipment.

NAVIGATION EQUIPMENT

The navigation equipment is of the electronic type and is described under COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT, this Section.

MISCELLANEOUS EQUIPMENT

LITTER LOADING DOOR

The litter loading door in the left side of the cabin, aft of the wing, is normally opened and closed hydraulically. Hydraulic pressure for operation of the door is supplied by the main hydraulic power supply system. The hydraulic units that operate the door are controlled by a selector valve mechanically linked to the door operating handle, located above and just forward of the door. Two latch operating handles on the inside of the door, and two handles on the outside of the door mechanically lock the door. The latch handles are operated manually from inside or outside before opening and after closing the door. An emergency handle above the aft side of the door releases the hinge pins and actuating linkages to jettison the door on the ground if hydraulic power is not available. The litter door jettison handle is to be in the socket only to jettison the door. During flight the emergency handle is removed and stowed on the rear side of the aft actuator housing.

Litter Door Latch Mechanism Flag

A small window, above the litter door in the aft litter door jettison mechanism panel, has a flag behind it which is the same color as the panel if the jettison mechanism is locked. If the jettison handle has been turned, a red flag will appear in the window. If the red flag is observed, the mechanism must be returned to the locked position and safety-wired by maintenance personnel.

ENGINE ANALYZER

Provision has been made for installation of a portable airborne engine analyzer in the rack aft of the copilot. The engine analyzer enables the operator to detect, locate, and identify engine abnormalities caused by a faulty ignition system. Analyses are accomplished through a series of ground runup and inflight checks utilizing the various components of the engine analyzer. Refer to IGNITION SYSTEM, Section VII.

WINDSHIELD WIPERS

A hydraulically operated windshield wiper is installed below each main windshield panel. Hydraulic pressure for operation of the wipers is obtained, through a control valve, from the hydraulic power supply system. The valve is operated mechanically by the windshield wiper knob.

Windshield Wiper Knob

The windshield wiper knob (5, figure 1-5), below the pilot's side windshield, is used to start, stop, and control the speed of the windshield wipers. The knob is marked ON and OFF with arrows to indicate direction of rotation.

Normal Operation of Windshield Wipers

1. Hydraulic pressure bypass handle – PRESS (DWN).
2. Windshield wiper knob – ON, as required.

Emergency Operation of Windshield Wipers

There are no provisions for emergency operation of the windshield wipers.

LITTER LOADING DOOR

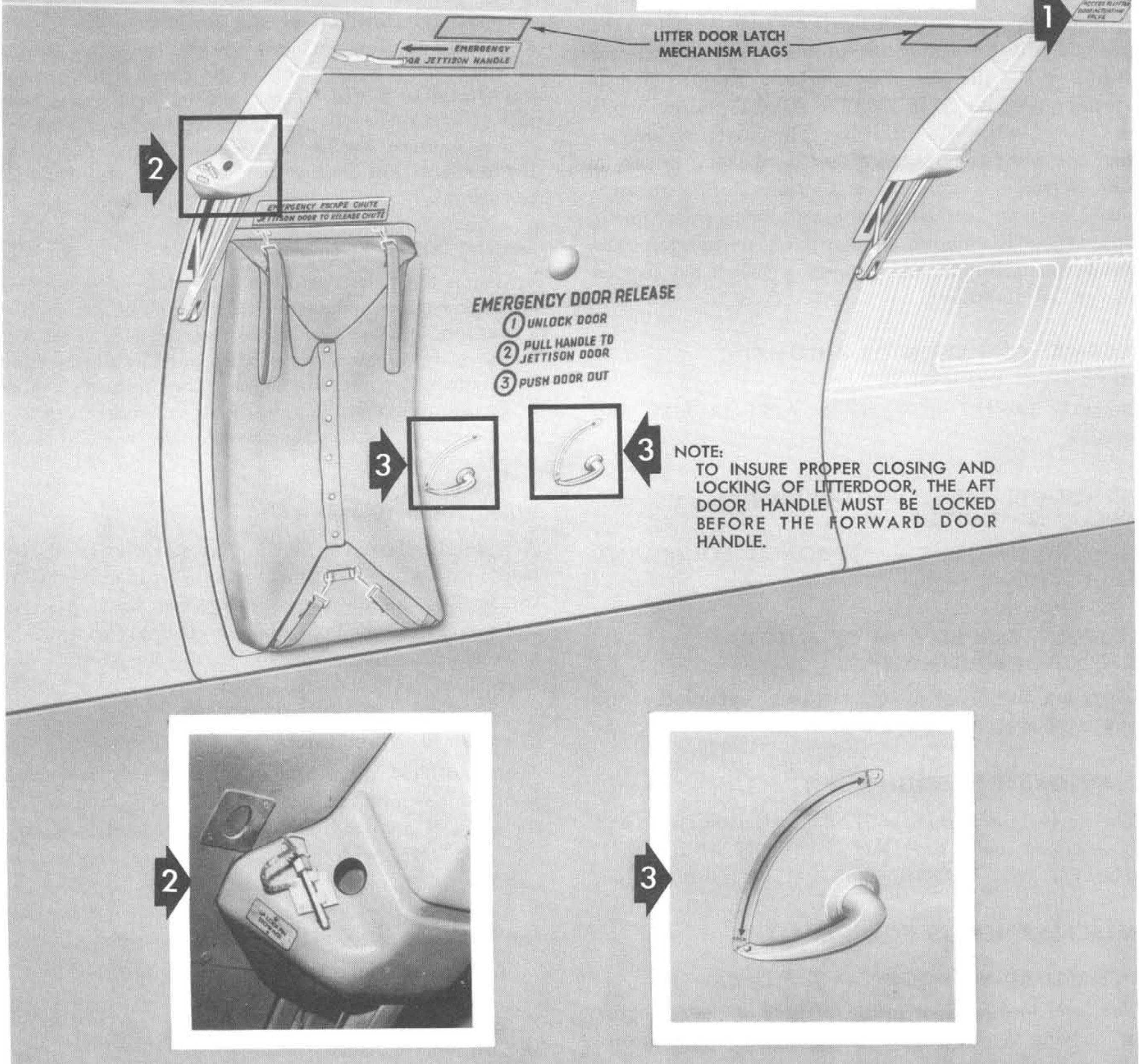
OPERATE VALVE TO OPEN DOOR

1. PLACE HANDLE IN NEUTRAL POSITION.
2. UP LOCK PINS MUST BE IN INDICATED STOWAGE POSITIONS.
3. UNLATCH DOOR.
4. PLACE HANDLE IN OPEN POSITION.
5. WITH DOOR OPEN INSERT LOCK PINS.
6. PLACE HANDLE IN NEUTRAL POSITION.

TO CLOSE DOOR

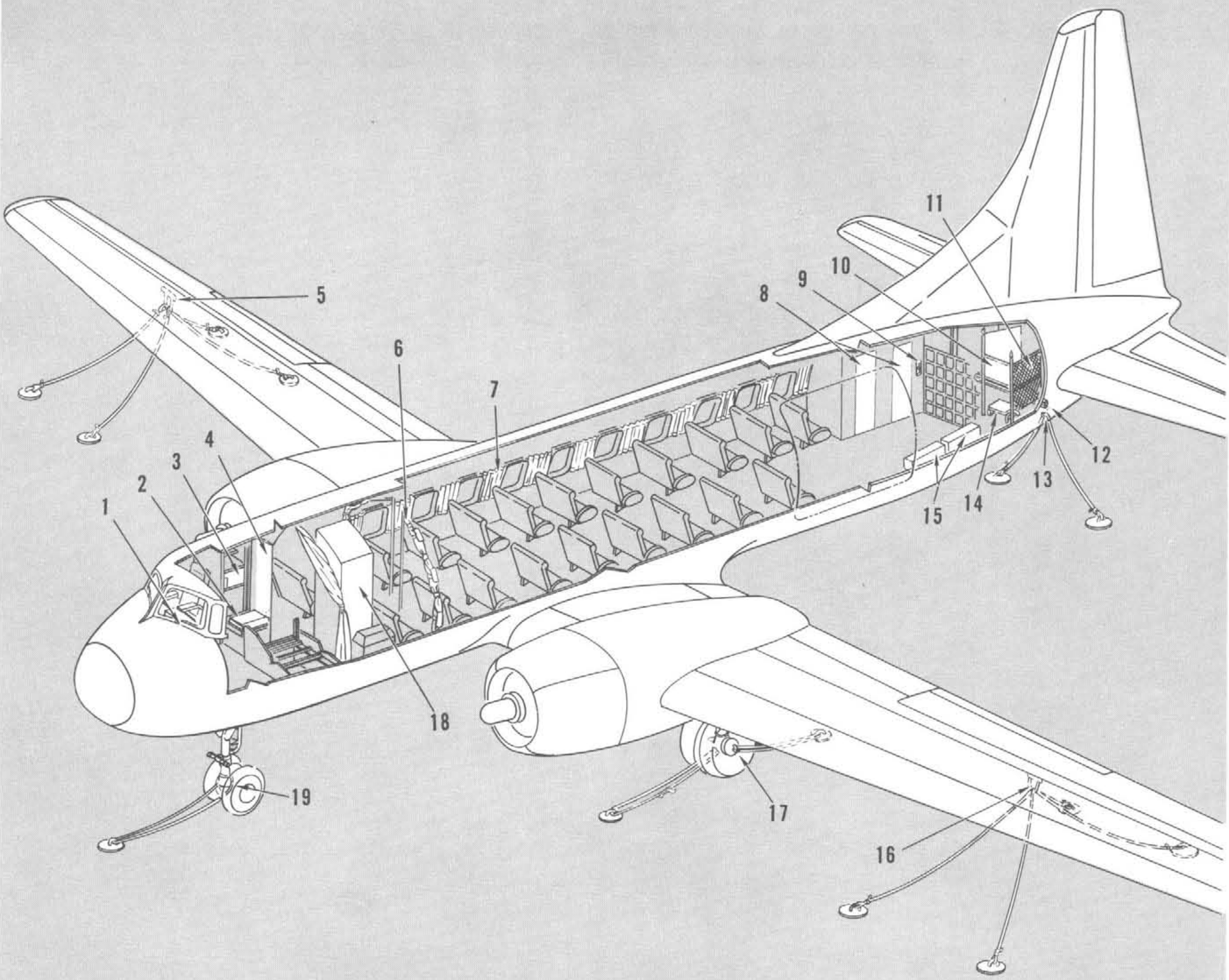
1. PLACE HANDLE IN OPEN POSITION AND BUILD UP HYDRAULIC PRESSURE.
2. REMOVE UP LOCK PINS FROM DOOR ACTUATING ARMS AND RETURN THEM TO STOWAGE POSITIONS.
3. PLACE HANDLE IN CLOSED POSITION.
4. WITH DOOR CLOSED, LATCH HOOKS.
5. PLACE HANDLE IN NEUTRAL POSITION.

NOTE:
EMERGENCY DOOR HANDLE IS STOWED AFT OF DOOR DURING FLIGHT.


1
1
EMERGENCY
DOOR JETTISON HANDLE
LITTER DOOR LATCH MECHANISM FLAGS
ACCESS TO LITTER DOOR ACTUATING VALVE
2
EMERGENCY ESCAPE CHUTE
JETTISON DOOR TO RELEASE CHUTE
EMERGENCY DOOR RELEASE
① UNLOCK DOOR
② PULL HANDLE TO JETTISON DOOR
③ PUSH DOOR OUT
3
3
2
3
24085

NOTE:
TO INSURE PROPER CLOSING AND LOCKING OF LITTERDOOR, THE AFT DOOR HANDLE MUST BE LOCKED BEFORE THE FORWARD DOOR HANDLE.

Figure 4-17



MISCELLANEOUS EQUIPMENT LOCATIONS

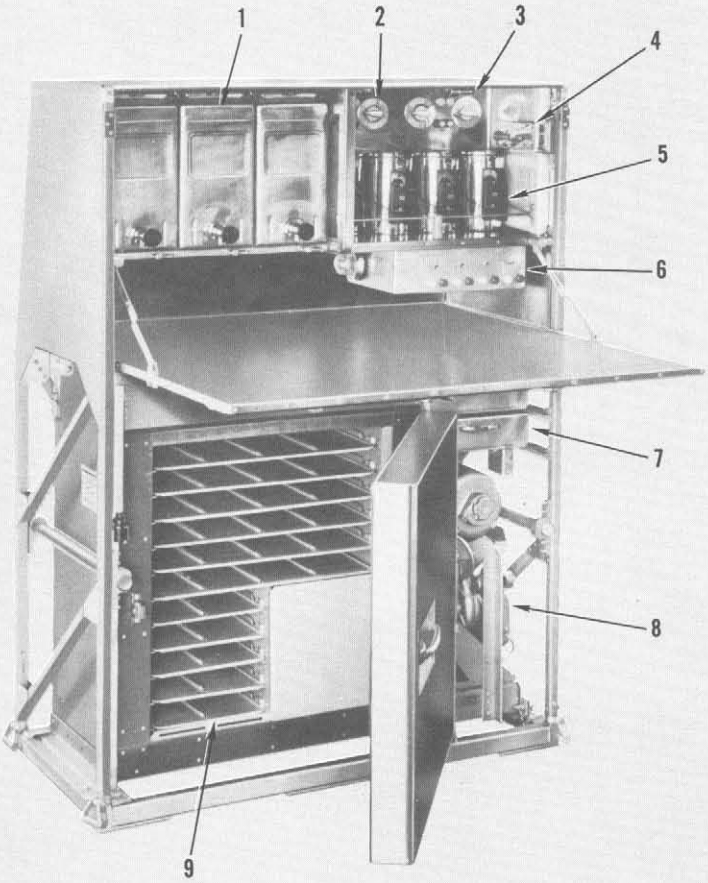
(TYPICAL)

1. Windshield Wipers
2. Flight Mechanic's Seat
3. Crew Locker
4. Flight Compartment Door
5. Right Wing Tie-down Fitting
6. Attendant's Safety Nets
7. Cabin Window Curtains
8. Lavatories
9. Drinking Water Dispenser
10. Rear Baggage Compartment
11. Modesty Curtain Stowage
12. Litter Stanchion Stowage
13. Tail Tie-down Fitting
14. Attendant's Portable Step Stool
15. Therapeutic Oxygen Kits
16. Left Wing Tie-down Fitting
17. Main Landing Gear Mooring
18. Galley
19. Nose Landing Gear Mooring

24086

Figure 4-18

GALLEY EQUIPMENT



1. Beverage Containers (3).
2. Hot Cup Timers (3).
3. Light.
4. Can Opener.
5. Hot Cups (3).
6. Switch Panel.
7. Utility Drawers (2).
8. Refrigeration Unit.
9. Refrigerator.

Figure 4-19

GALLEY

A galley is installed in the forward end of the cabin opposite the main entrance door. It incorporates electrically operated hot cups, beverage containers, food storage space and a refrigerator. The galley can be removed.

Galley Power Receptacle

An electrical outlet located on the outboard aft side of the radio rack provides 28-volt dc power from the essential dc bus, and 115-volt unregulated ac power from bus No. 2, for operation of galley equipment.

MEDICAL EQUIPMENT POWER SUPPLY

Electrical power for operation of an iron lung or other medical equipment is provided by two outlets in the main cabin. The aft outlet located on the right cabin wall and the forward outlet on the left cabin wall adjacent to the medical power control box (figure 4-20), supply 28-volt dc power from the emergency bus. The control box contains a circuit breaker for each outlet and a three-position selector switch. The switch has ON AFT, OFF, and ON FWD positions.

LITTER LIFT POWER RECEPTACLE

Electrical power for operation of a litter lift is provided by an outlet under the cabin floor in the area of the litter loading door. It is accessible from the outside through a door in the bottom center of the fuselage. The litter lift is 28-volt dc powered from the external power bus. A control box attached to the litter lift contains the actuating switches.

FLIGHT MECHANIC'S SEAT

The flight mechanic's seat (14, figure 1-4) is mounted on rails in a rack below the parachute stowage racks behind the copilot's seat. When the seat is to be used, it is pulled out across the passageway until two pins in the left edge of the seat engage two latches in the radio rack. The seat is stowed by pulling up on a latch wire on the radio rack and pushing the seat into its stowage rack below the parachutes. A safety belt is attached to the seat.

CABIN SEATS

One row of double seats facing aft, installed on each side of the cabin, and a single seat on the right side forward provide seating accommodations for 39 passengers and attendants. The seats are upholstered commercial type with adjustable back rests.

SAFETY BELTS

A safety belt is attached to each seat.

LITTER SUPPORTS

Twenty-seven litters can be installed in place of 32 seats. Stowage facilities for the litter stanchions and straps are provided in the aft baggage compartment (figure 4-18).

FLIGHT COMPARTMENT DOOR

A metal door is installed between the flight compartment and the cabin (see figure 1-4). The door is equipped with a lock and a small observation window.

CURTAINS

Curtains are provided at all cabin windows. Four sets of modesty curtains are provided to enclose any or all of the litters in one tier. Stowage provisions for the modesty curtains are installed in the aft baggage compartment (figure 4-18).

SAFETY NETS

A safety net is installed on each side of the cabin between the forward litter tiers and the attendants' seats. When not in use the nets are rolled and secured to the cabin walls (figure 4-18).

DATA CASE, FLIGHT REPORT STOWAGE, AND CHECKOFF LIST STOWAGE

A data case is located to the left of the pilot's seat (24, figure 1-4). The case incorporates a holder for checkoff lists.

PORTABLE STEP-STOOL

A small portable step-stool is provided to enable the attendants to serve the upper litters. When not in use, the stool is stowed in the aft baggage compartment (figure 4-18).

DRINKING WATER TANK AND CUP DISPENSER

A two-gallon drinking water jug (figure 4-18) is mounted on the inboard wall of the aft lavatory compartment. A cup dispenser is located above the water faucet.

MEDICAL POWER CONTROL BOX

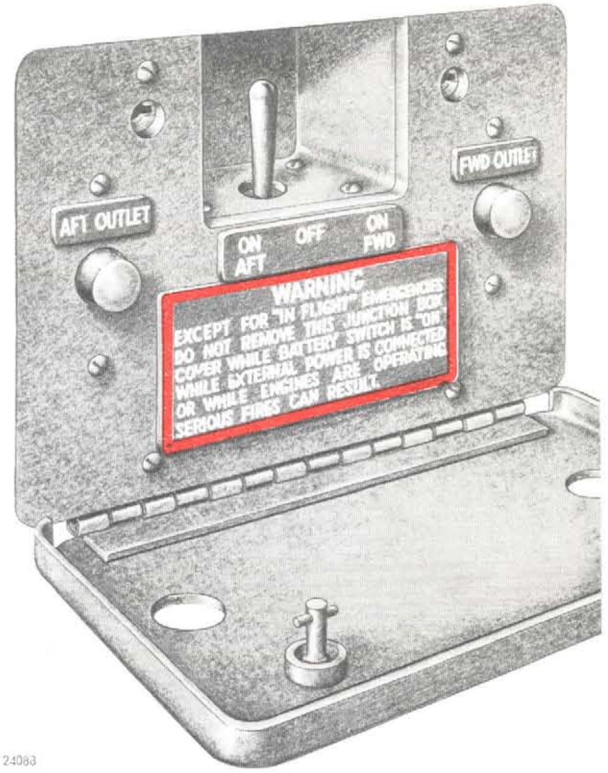

AFT OUTLET
FWD OUTLET
ON AFT
OFF
ON FWD
WARNING
EXCEPT FOR "IN FLIGHT" EMERGENCIES DO NOT REMOVE THIS JUNCTION BOX COVER WHILE BATTERY SWITCH IS "ON" WHILE EXTERNAL POWER IS CONNECTED OR WHILE ENGINES ARE OPERATING SERIOUS FIRES CAN RESULT.
24083

Figure 4-20

LAVATORIES

Separate lavatory facilities (figure 4-18) are provided for men and women in the aft section of the cabin. Each compartment contains a chemical toilet and a wash stand. The forward compartment, in addition, is equipped with a urinal.

LOAD ADJUSTER

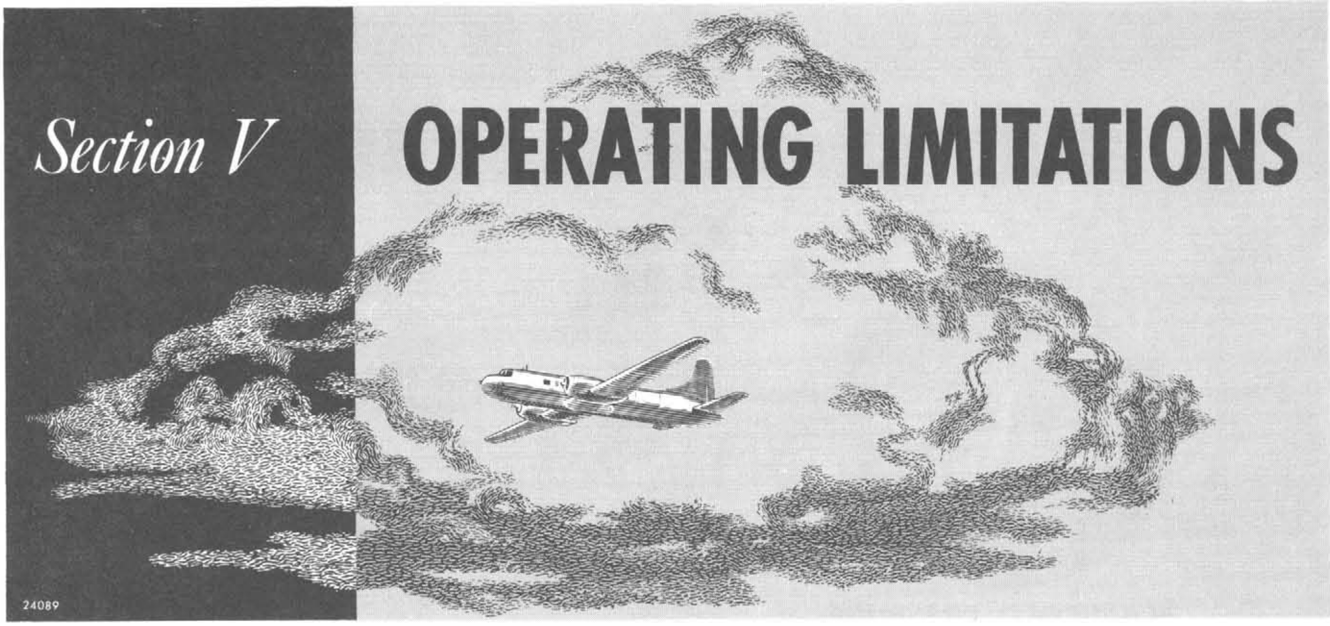
A load adjuster and case is stowed on a clip in the crew locker.

BAGGAGE COMPARTMENT AND CARGO NETS

The baggage compartment at the aft end of the cabin is enclosed by nylon web gates. Webbing separators divide this area into three compartments to provide stowage for miscellaneous equipment and baggage. In addition, web gates and stanchions are provided to enclose the area of the rearmost litter tier when the litters are not installed (figure 4-18). Four cargo tie-down nets enable stowage of light parcel type cargo in this area.

EMERGENCY RADIO TRANSMITTER STOWAGE

Provisions are made for stowing the AN/CRT-3 emergency radio transmitter in the aft baggage compartment (figure 3-3). The straps have quick-release fasteners.



Section V

OPERATING LIMITATIONS

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INTRODUCTION

This airplane possesses certain well-defined limitations which must be observed if safety and efficiency are to be attained. The high-performance features compel a rigid adherence to these limitations. This is true of the engines and some of the auxiliary equipment, as well as of the airplane itself. It is therefore important that you study this Section carefully to familiarize yourself with the limitations as shown herein by illustrations and explanatory text. The knowledge thus gained will result in more proficient operation of the airplanes.

INSTRUMENT MARKINGS

Instrument markings shown in figure 5-1 and operating limitations in this Section are not repeated elsewhere in this manual.

EXPLANATION OF MARKINGS

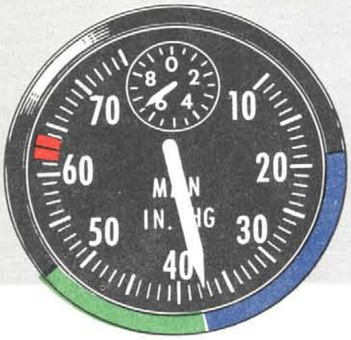
Lower Red Radial

The red radial having the lowest numerical value on an instrument indicates that a dangerous condition would exist if the pointer should drop to or below that value in flight. Conditions other than inflight may be specified where applicable.

INSTRUMENT MARKINGS

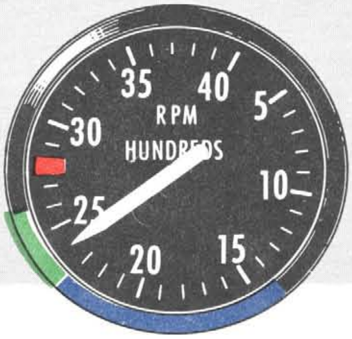
FUEL GRADE

115/145



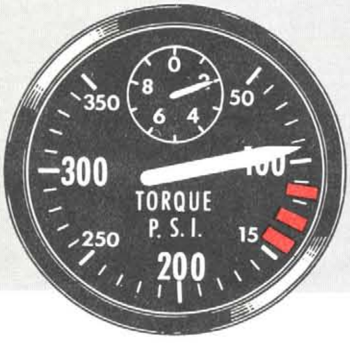
MANIFOLD PRESSURE

🟦	19 to 38 in.	Auto-lean or Manual lean permitted
🟩	38 to 51.5 in.	Auto-rich or manual adjust
🟩	51.5 in. (Sea level)	METO-Low Blower (operation above 51.5 in. limited to 5 min at Maximum Power or 30 min at Military Power)
🟥	63.0 in.	Maximum (dry) S.L.
🟥	62.0 in.	Maximum (wet) S.L.



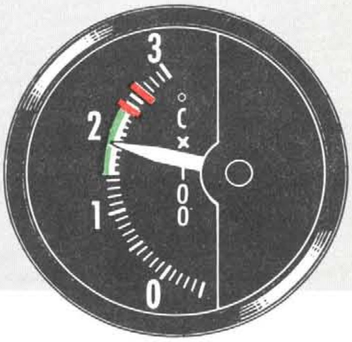
TACHOMETER

🟦	1400 to 2300 rpm	Auto-lean or manual lean permitted
🟩	2300 to 2600 rpm	Auto-rich or manual adjust
🟩	2600 rpm	METO (operation above this rpm limited to 5 min at Maximum Power or 30 min at Military Power)
🟥	2800 rpm	Maximum (wet or dry)



TORQUEMETER

🟥	115 psi	METO-Low Blower (operation above this pressure limited to 5 min at Maximum Power or 30 min at Military Power)
🟥	130 psi	Maximum (dry)
🟥	141 psi	Maximum (wet)



CYLINDER HEAD TEMPERATURE

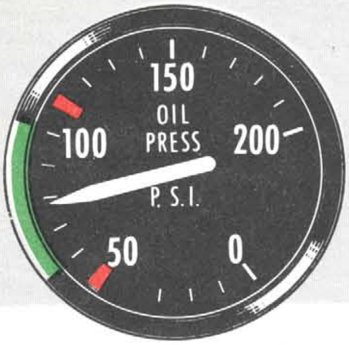
🟩	150° to 232°C	Continuous operation (150°C to 205°C desired)
🟥	232°C	Maximum Auto-lean or manual lean (except below 1100 bhp during icing conditions)
🟥	260°C	Maximum Auto-rich

24090-1

Figure 5-1. (Sheet 1 of 5)

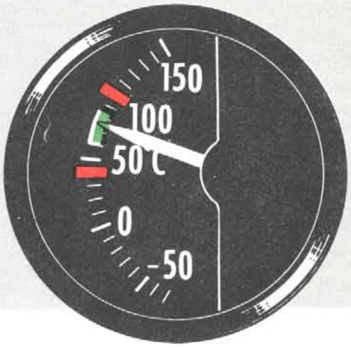
INSTRUMENT MARKINGS

FUEL GRADE
115/145



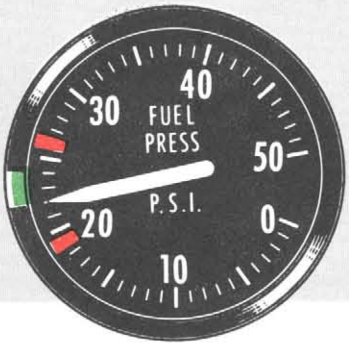
OIL PRESSURE

🟥	50 psi	Minimum at 1400 rpm (25 psi permissible for idle)
🟩	60 to 100 psi	Continuous operation
🟥	110 psi	Maximum



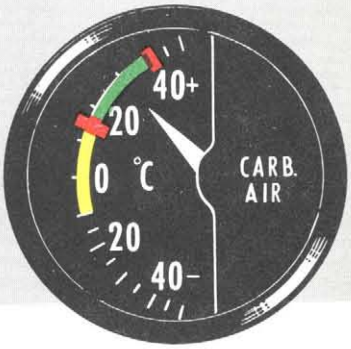
OIL TEMPERATURE

🟥	40°C	Minimum
🟩	60° to 85°C	Continuous operation
🟥	100°C	Maximum



FUEL PRESSURE

🟥	19 psi	Minimum
🟩	22 to 24 psi	Continuous operation
🟥	26 psi	Maximum



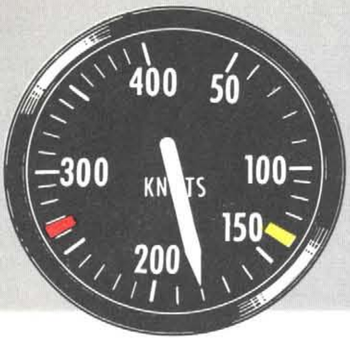
CARBURETOR AIR TEMPERATURE

🟨	-10° to +15°C	Danger of icing
🟥	15°C	Maximum-high blower (except below 1100 BHP during icing conditions)
🟩	15° to 40°C	Continuous operation
🟥	40°C	Maximum-low blower (when carburetor heat is used)

24090-2

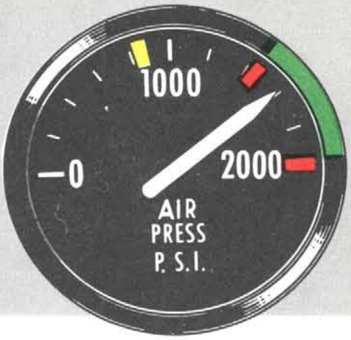
Figure 5-1. (Sheet 2 of 5)

INSTRUMENT MARKINGS



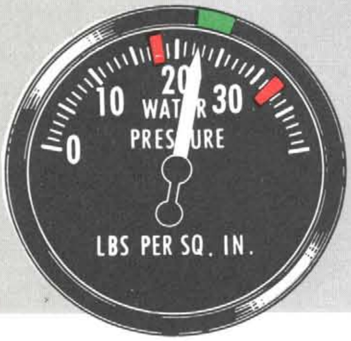
AIRSPEED

🟨	141 knots	Full Flaps (landing gear – 176 knots)
🟥	266 knots	Maximum (sea level to 16,500 ft.)



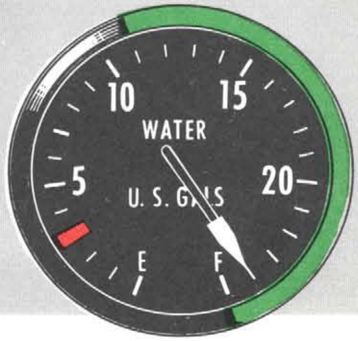
EMERGENCY AIR PRESSURE

🟨	850 psi	One brake application remaining
🟥	1450 psi	Minimum
🟩	1450 to 2000 psi	Normal
🟥	2000 psi	Maximum



WATER PRESSURE

🟥	18 psi	Minimum
🟩	22 to 25 psi	Continuous operation
🟥	32 psi	Maximum



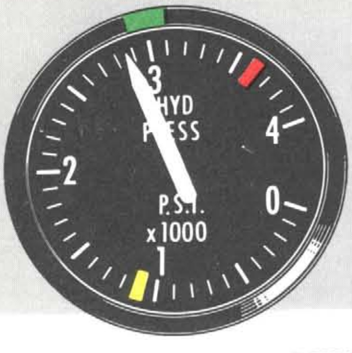
WATER QUANTITY

🟩	11 to 25 gallons	Desired for take-off
🟥	3 gallons	Injection system cut-off

24090-3

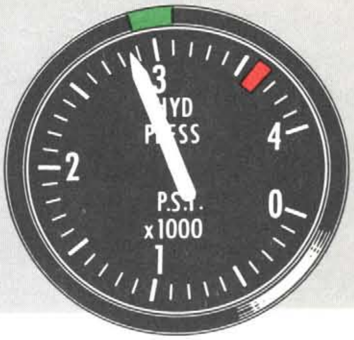
Figure 5-1. (Sheet 3 of 5)

INSTRUMENT MARKINGS



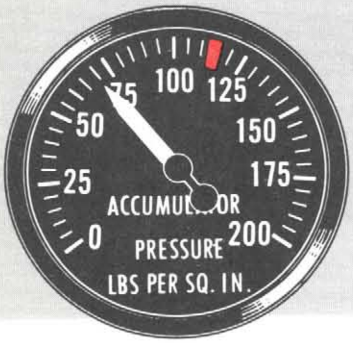
HYDRAULIC BRAKE PRESSURE

🟨	1100 psi	One brake application remaining
🟩	2900 to 3100 psi	Normal
🟥	3600 psi	Maximum



MAIN HYDRAULIC PRESSURE

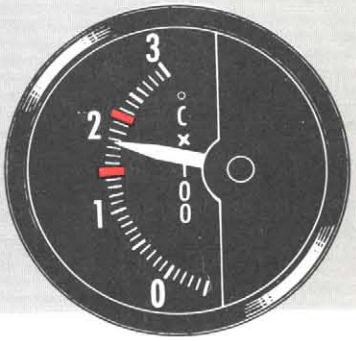
🟩	2900 to 3100 psi	Normal
🟥	3600 psi	Maximum



NITROGEN PRESSURE ALTERNATOR AND GENERATOR HYDRAULIC SYSTEM ACCUMULATOR

🟥	113 psi	Maximum

(Refer to placard adjacent to gage for other information)



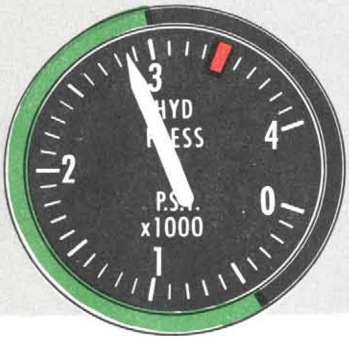
WING AND TAIL TEMPERATURE

🟥	150°	Maximum with structural overheat limit override switch in OVERRIDE
🟥	220°	Maximum

24090-4

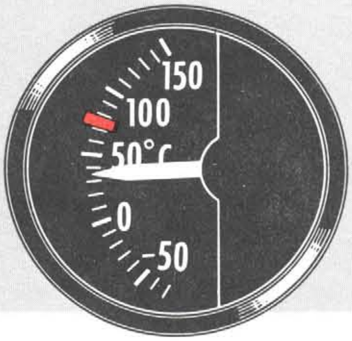
Figure 5-1. (Sheet 4 of 5)

INSTRUMENT MARKINGS



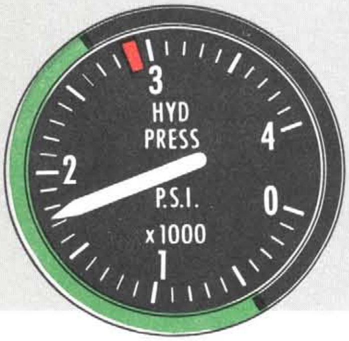
HYDRAULIC DRIVE ALTERNATOR – GENERATOR

🟩	500 to 3000 psi	Normal
🟥	3400 psi	Maximum



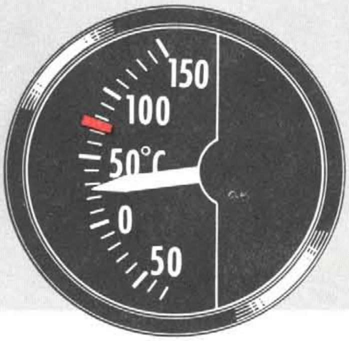
HYDRAULIC TEMPERATURE ALTERNATOR – GENERATOR

🟥	75°C	Maximum



HYDRAULIC DRIVE CABIN COMPRESSOR

🟩	500 to 2700 psi	Normal
🟥	2900 psi	Maximum



HYDRAULIC TEMPERATURE CABIN COMPRESSOR

🟥	75°C	Maximum

24090-5

Figure 5-1 (Sheet 5 of 5)

Yellow Arc

The yellow arc indicates that danger may exist under certain specific conditions. These conditions are defined in figure 5-1 wherever the yellow arc appears.

Blue Arc

The blue arc is reserved for certain engine instruments and indicates the permissable range of that instrument when operating with the carburetor mixture control in auto-lean or manual lean.

Green Arc

The green arc indicates the region for continuous operation. When used in conjunction with the blue arc, green takes on a special meaning requiring auto-rich operation when the pointer is in this region.

Upper Red Radial

The red radial having the highest numerical value on an instrument indicates that a dangerous condition would exist if the pointer should reach this point. Operation above this value is prohibited.

Unmarked Areas

Unmarked or blank areas between the lower and upper red radials indicate regions of undesirable operation or regions in which operation is limited. Operation in an unmarked area should be avoided.

Index Mark

A white index mark appears on all instruments having range markings on the glass. The mark is used to indicate any movement between the glass and the case and thus reveal any errors in the location of the markers caused by such movement.

MINIMUM CREW

The minimum crew requirements for this airplane are a pilot, a copilot, and a flight mechanic. Additional crew members as required will be added at the discretion of the commanding officer.

ENGINE LIMITATIONS

Engine limitations are marked on the instruments (figure 5-1). In addition, the following limitations should be observed:

CAUTION

When manifold pressure exceeds the values specified for takeoff, climb, or cruise, the amount of overboost and length of time shall be entered on Form 781.

Note

If it is necessary to raise cylinder head temperature above 205°C in flight to provide adequate wing heat during manual lean operation, engine power should not be allowed to exceed 1100 bhp.

Cylinder head temperatures:

Maximum desirable prior to takeoff – 170°C.

Minimum prior to takeoff – None.

Maximum before stopping engines – 200°C.

Oil pressures:

Minimum at 2600 rpm and 75°C (100°C in climb) – 75 psi.

Minimum, idling – 25 psi.

Carburetor air temperatures:

Maximum, low blower (when carburetor heat is used) – 40°C.

Maximum, high blower – 15°C.

Note

- When using alternate fuel grade 100/130, do not exceed 1100 bhp in high blower.
- At 1200 bhp high blower cruise or less, the limiting CAT can be increased to 30°C if icing conditions warrant, provided cylinder head temperatures are maintained below 205°C with not more than the recommended torque pressure drop from best power. Use minimum carburetor heat necessary to prevent carburetor icing.

MAXIMUM POWER LIMITATIONS

Maximum power (dry or wet) is limited to five minutes. Refer to INSTRUMENT MARKINGS, this Section, for all limits, and to the Appendix for available power. Military power is the same as maximum power (dry) and is limited to 30 minutes. An airplane engine can actually be run continuously under overload conditions of power and speed for much longer periods than those permitted by the ratings. However, the period of reliable operation is thereby reduced to an unreasonably short time. By imposing a time limit on maximum and military power ratings, the cumulative effect of the overloads is distributed evenly over the period between overhauls, and the useful life of the engine is lengthened accordingly. When use of military power is absolutely required for longer than 30 minutes, a notation must be made on Form 781. METO power has no time limitation.

FUEL OPERATING LIMITS

STANDARD ATMOSPHERE

NORMAL FUEL GRADE OPERATING LIMITS 115/145 GRADE FUEL

LOW BLOWER	BHP	RPM	MAP	MIXTURE	TORQUE	CAT
MAXIMUM (WET)	2500	2800	62.0-SEA LEVEL * 61.0-3,800 FT.	AUTO-RICH	141	**
MAXIMUM (DRY)	2300	2800	63.0-SEA LEVEL * 62.5-3,300 FT.	AUTO-RICH	130	**
METO	1900	2600	51.5-SEA LEVEL * 50.0-7,100 FT.	AUTO-RICH	115	**
HIGH BLOWER						
METO	1700	2600	50.0-10,000 FT. * 47.5-15,900 FT.	AUTO-RICH	103	15°

* MAXIMUM MANIFOLD PRESSURE PERMITTED AT CRITICAL ALTITUDE.
** MAXIMUM CAT LIMIT IN LOW BLOWER IS 40° C WITH CARBURETOR HEAT APPLIED.

OPERATION AT MAXIMUM POWER WET OR DRY LIMITED TO 5 MINUTES
OPERATION AT MILITARY POWER LIMITED TO 30 MINUTES.

MAXIMUM TORQUE PRESSURE PERMITTED DURING AUTO-LEAN OR MANUAL LEAN IS 87 PSI IN LOW BLOWER AND 84 PSI IN HIGH BLOWER.

ALTERNATE FUEL GRADE OPERATING LIMITS 100/130 GRADE FUEL

LOW BLOWER	BHP	RPM	MAP	MIXTURE	TORQUE	CAT
MAXIMUM (WET)	2400	2800	59.5-SEA LEVEL * 58.5-5,000 FT.	AUTO-RICH	135	**
MAXIMUM (DRY)	1950	2800	53.0-SEA LEVEL * 51.0-9,900 FT.	AUTO-RICH	110	**
ALTERNATE (DRY)	2050	2700	55.0-SEA LEVEL * 53.0-6,700 FT.	AUTO-RICH	120	**
METO	1800	2600	48.5-SEA LEVEL * 46.5-9,200 FT.	AUTO-RICH	109	**
HIGH BLOWER						
METO	1600	2600	46.0-10,000 FT. * 44.5-18,700 FT.	AUTO-RICH	103	15°

* MAXIMUM MANIFOLD PRESSURE PERMITTED AT CRITICAL ALTITUDE.
** MAXIMUM CAT LIMIT IN LOW BLOWER IS 40° C WITH CARBURETOR HEAT APPLIED.

OPERATION AT MAXIMUM POWER WET OR DRY LIMITED TO 5 MINUTES

MAXIMUM TORQUE PRESSURE PERMITTED DURING AUTO-LEAN OR MANUAL LEAN IS 87 PSI IN LOW BLOWER AND 84 PSI IN HIGH BLOWER.

MAP: IN. HG.
TORQUE: PSI
CAT: °C

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Figure 5-2

PROPELLER LIMITATIONS

Maximum speed with feathered propeller – 190 KIAS.

Note

> The propeller feathering stop is adjusted so that at 190 KIAS, the feathered propeller will not windmill.

To preclude overspeeding, do not unfeather a propeller at airspeeds in excess of 130 KIAS. Hold propeller speed lever to DECREASE RPM until limit light comes on before unfeathering. Do not use tachometer indication as evidence of propeller unfeathering. Watch propeller and release the feathering button when a propeller rotation first starts. When unfeathering at night, use wing leading edge inspection lights to watch propeller.

CAUTION

> If engine overspeeding occurs, land as soon as practicable. Note all conditions of overspeeding on Form 781. If engine rpm was between 3100 and 3400, the engine must be inspected before the next flight. If engine rpm exceeded 3400, the engine must be changed before the next flight.

ALTERNATOR-GENERATOR HYDRAULIC SYSTEM LIMITATIONS

The minimum engine rpm required to obtain rated power output from either generator is 1000 rpm; and from either alternator, 1250 rpm.

AIRSPEED LIMITATIONS

Note

> All airspeeds are estimated. They contain corrections for position errors but do not contain corrections for instrument errors.

WING FLAP EXTENSION SPEED LIMITATIONS

To avoid imposing excessive airloads on the airplane structure do not exceed:

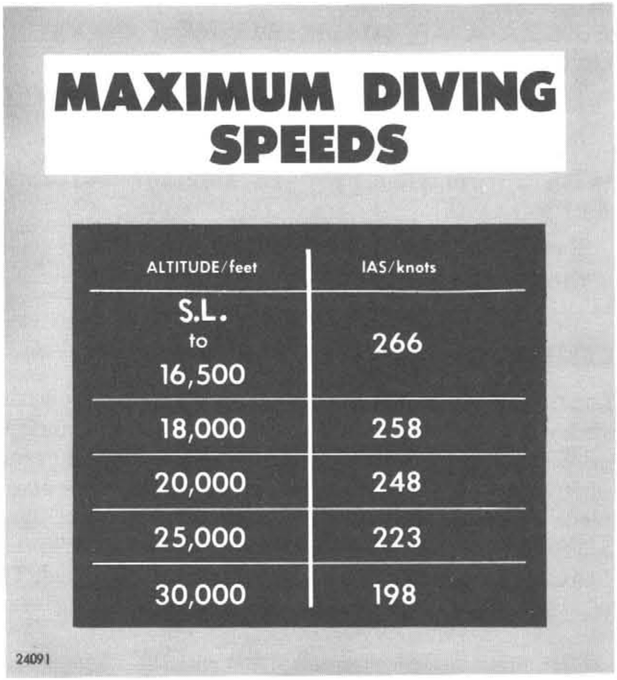
Approach Flap Setting	Maximum Airspeed
12°	200 KIAS
15°	188 KIAS
20°	176 KIAS
30°	156 KIAS
39°	141 KIAS

LANDING GEAR RETRACTION SPEED LIMITATION

To avoid excessive stress to landing gear actuating mechanism, begin gear retraction before reaching 132 KIAS.

LANDNG GEAR EXTENSION SPEED LIMITATION

Do not lower the landing gear at speeds in excess of 176 KIAS. The airplane structure is not designed to withstand the stresses imposed on the gear above this speed.



MAXIMUM DIVING SPEEDS

ALTITUDE/feet	IAS/knots
S.L. to 16,500	266
18,000	258
20,000	248
25,000	223
30,000	198

Figure 5-3

LANDING LIGHT EXTENSION SPEED LIMITATIONS

To prevent damage by wind drag do not extend the landing lights at speeds in excess of 176 KIAS.

SPEED LIMITATION WITH FULL AILERON DEFLECTION

To prevent damage to the ailerons and their controls, do not exceed 157 KIAS with full aileron deflection.

MAXIMUM DIVING SPEEDS

See figure 5-3.

MANEUVER LIMITATIONS

MAXIMUM BANK WHILE TURNING

In order to avoid structural damage to the airplane or to avoid an accelerated stall, do not exceed 60° bank while turning.

PROHIBITED MANEUVERS

All acrobatics are prohibited.

EQUIPMENT LIMITATIONS

AUTOMATIC PILOT OPERATING LIMITATIONS

Bank	40°
Climb or descent	10°
Aileron trim	7.5° bank in either direction
Elevator trim (automatic)	15° nose-down 15° nose-up

AUTOMATIC APPROACH EQUIPMENT OPERATING LIMITATIONS

With automatic approach selector switch on LOCALIZ:

Bank	25°

With automatic approach selector switch on APPROACH:

Bank	10°
Climb or descent	5°

CENTER OF GRAVITY LIMITATIONS

Loading of this airplane must be accomplished in accordance with the Center of Gravity Chart in the Handbook of Weight and Balance Data, T. O. 1-1B-40. The permissible center of gravity range for takeoff and landing is from 17% MAC to 31% MAC. The permissible center of gravity range for climb and level flight is from 13% MAC to 33% MAC with the landing gear retracted. This range allows unrestricted crew movement during flight.

WEIGHT LIMITATIONS

Weight, more than any other single factor, will determine the capability and performance of an airplane. An airplane is designed with sufficient strength to accomplish a certain basic mission without undue allowance for overloading or improper weight distribution. If these limitations are exceeded, a loss in the performance of the airplane is inevitable and structural failure is quite probable. When an airplane is loaded beyond the established limits, ceiling and range are decreased, control forces and stalling speeds become higher, and the rate of climb falls off rapidly as the gross weight is increased. The takeoff and landing rolls increase appreciably with an increase in gross weight. Likewise, the brakes are insufficient to brake the forward momentum of the airplane, and the wings are more vulnerable to air loads during maneuvers or flight through turbulent air.

SPACE CAPACITY

The space capacity may limit the alternate load that can be carried in an airplane; however, this does not usually apply to cargo airplanes.

WEIGHT AND LOADS

In any condition of static equilibrium during straight and level flight or at rest on the ground, the airplane is subjected to the pull of gravity, the strength of which is spoken of as 1g. As fuel, crew, alternate load, and additional equipment are added in order that the airplane may accomplish a specific mission, the weight of the airplane correspondingly increases and the additional weight constitutes a force acting on the airplane structure. The weight of the airplane, or the force which gravity imposes on the airplane, may also be considered as a load. On the ground this load must be sustained by the landing gear; in flight, by the wings. There is a limit to the load which the landing gear is capable of supporting during taxi, takeoff, and landing operations. There is also a limit to the load which the wings can sustain in flight. During maneuvering and flight through turbulent air, additional loads are imposed on the airplane. These loads, caused by acceleration of the airplane, are the result of forces which, in addition to that of gravity, act upon the total mass of the loaded airplane. Both of these forces tend to produce undesirable and potentially dangerous loads on the airplane structure. This is particularly true of the wings which must sustain the airplane in flight. When the weight of the airplane is increased, the wings become more and more vulnerable to the loads imposed by sudden changes in air currents or manipulation of the controls. The ultimate strength of the airplane structure is eventually exceeded by the combined forces of weight and air loads. When this condition occurs, structural failure results. As the maximum weight which the airplane can safely carry is dependent upon the distribution of the weight throughout the airplane and its capacity to sustain air loads in accelerated flight, an understanding of weight limitations is required to accomplish a mission successfully.

DISTRIBUTION OF LOAD

The maximum load that the airplane can carry also depends on the way the load is distributed in the airplane. The weight of an airplane in flight is supported largely by the wings; therefore, as the load carried in the fuselage is increased, the bending moment on the wings is increased. An airplane might safely carry 17,000 pounds if 8,000 were carried in the fuselage and 9,000 pounds of fuel were in the wings, but 17,000 pounds might be an unsafe load if the weight distribution were 12,000 pounds in the fuselage and 5000 pounds in the wings – due to the excessive bending moment imposed on the wings by the 12,000 pounds in the fuselage. See figure 5-4.

LOAD FACTORS

A load factor is the ratio of the load imposed on the airplane when accelerated in any direction as compared with the load imposed on the airplane by gravity in any condition of static equilibrium. The load factor denotes the strength of the forces acting on the airplane due to the sudden changes in air currents and manipulation of the controls, and is expressed by the term g, which is the gravitational force. When the airplane enters a region of turbulent air or the airplane is maneuvered, additional forces are imposed on the structure. The additional load on the wings resulting from these forces is expressed in relation to the gravitational force and referred to as 0.5g, 2.0g, 3.0g, etc. which means that force exerted on the wing structure and its members are 0.5, 2, or 3 times the force exerted by gravity. For example, if the normal weight of the airplane is 40,000 pounds and the load factor at any given moment of accelerated flight is 3.0g, the total force which the wings must sustain is 120,000 pounds or three times the normal weight of the airplane in straight and level flight.

MARGIN OF SAFETY

The margin of safety is the range of forces which exists between two points, one of which is the load factor the airplane is sustaining at any given moment and the other is the load factor at which structural damage will occur. If, for example, the airplane is incapable of sustaining a load factor greater than 3.0g and during flight through turbulent air is subjected to a force of 1.5g, the margin of safety at this particular moment is 1.5g. When fuselage loads are increased, the margin of safety decreases. This is also true, to a lesser degree, when wing fuel is increased. This increase in weight actually becomes a component of the forces acting on the airplane, and, as such, lessens the capacity of the airplane to sustain further loads due to accelerated flight. For this reason it is advisable in loading an airplane to maintain a margin of safety which will never be exceeded during any period of flight. *Experience has shown that an airplane should never be overloaded to the point where it cannot make good a load factor of 2.0* because almost any mission, even with ideal conditions, will subject the airplane at one time or another to load factors of at least 2.0.

EXPLANATION OF THE CHART

The weight limitation chart (figure 5-4) presents graphically the weight-carrying capabilities of the airplane as defined by the various criteria which provide limits for safe and efficient operation. Through the use of the chart, the flight planner is aided in recognizing the weight limitations which will restrict operation in a specific mission and in determining what margin of safety may be established.

Operating Weight

The operating weight on which the weight limitation chart is based is 30,000 pounds. This value is an approximate weight which includes the airplane basic weight shown in the Handbook of Weight and Balance Data, T.O. 1-1B-40, plus the standard crew and full oil capacity. Since individual airplane basic weights will vary, it will be necessary to adjust the chart for a specific airplane. The intersection of the alternate load and fuel load axes at zero represents the airplane operating weight of 30,000 pounds.

Gross Weight

The diagonal lines on the weight limitation chart indicate the gross weight of the loaded airplane.

Note

The gross weight of the airplane should never exceed that required for the mission since unnecessary risk and wear of the equipment will otherwise result. Takeoff gross weights must also be considered in light of available runways, surrounding terrain, altitude, atmospheric conditions, mission requirements, and the urgency of the mission.

Landing Weight Limitation

The recommended maximum landing weight of 41,500 pounds is based on landing gear structural limitations. Although this figure allows a margin of safety for the occasional "hard" landing, landings in excess of 41,500 pounds will reduce landing gear life and reduce brake effectivity and life. Landings at gross weight above the recommended maximum should be made only in case of emergency and then with extreme care.

Performance Limitations

In the case of two-engine airplanes, it is generally inherent that performance rather than structural limitations restrict the weight which the airplane can carry. Obviously, the gross weight must necessarily be limited by the ability of the airplane to take off within the available runway length and clear any obstacles. But the primary consideration is the ability of the airplane to fly with partial power. Single-engine performance, then, is the major restrictive factor in the loading of the airplane. Note the gross weight lines on the chart, particularly those which separate the loading areas. Each of these lines defines a specific performance limitation. These performance limitations are based on the gross weight at which an adequate rate-of-climb can be maintained under various conditions of power, temperature, and configuration.

Power Loss and Performance

In two-engine airplanes, the effect of engine failure on airplane performance is immediate. The loss of half the total thrust normally developed by both engines and the asymmetric power condition which results produces a marked decrease in the rate-of-climb. Power losses due to temperature, humidity, and engine deficiency exert a considerable influence on the rate-of-climb even when both engines are operating. It is not difficult to visualize the effect which engine failure will produce on the rate-of-climb, but it is interesting to note the remarkable difference in airplane performance resulting from a rise in temperature and a corresponding fall in air density. Refer to the Appendix for performance data under various conditions and configurations.

Recommended Loading Area

The green area on the weight limitation chart (figure 5-4) represents the loading conditions that present no particular problem in regard to strength or performance of the airplane at normal takeoff flap setting of 12°. The area is defined by the gross weight diagonal which indicates a rate of climb at sea level of 100 fpm on a hot day with one propeller feathered, gear up, wing flaps at 12°, and maximum dry power on the operating engine.

WEIGHT LIMITATION

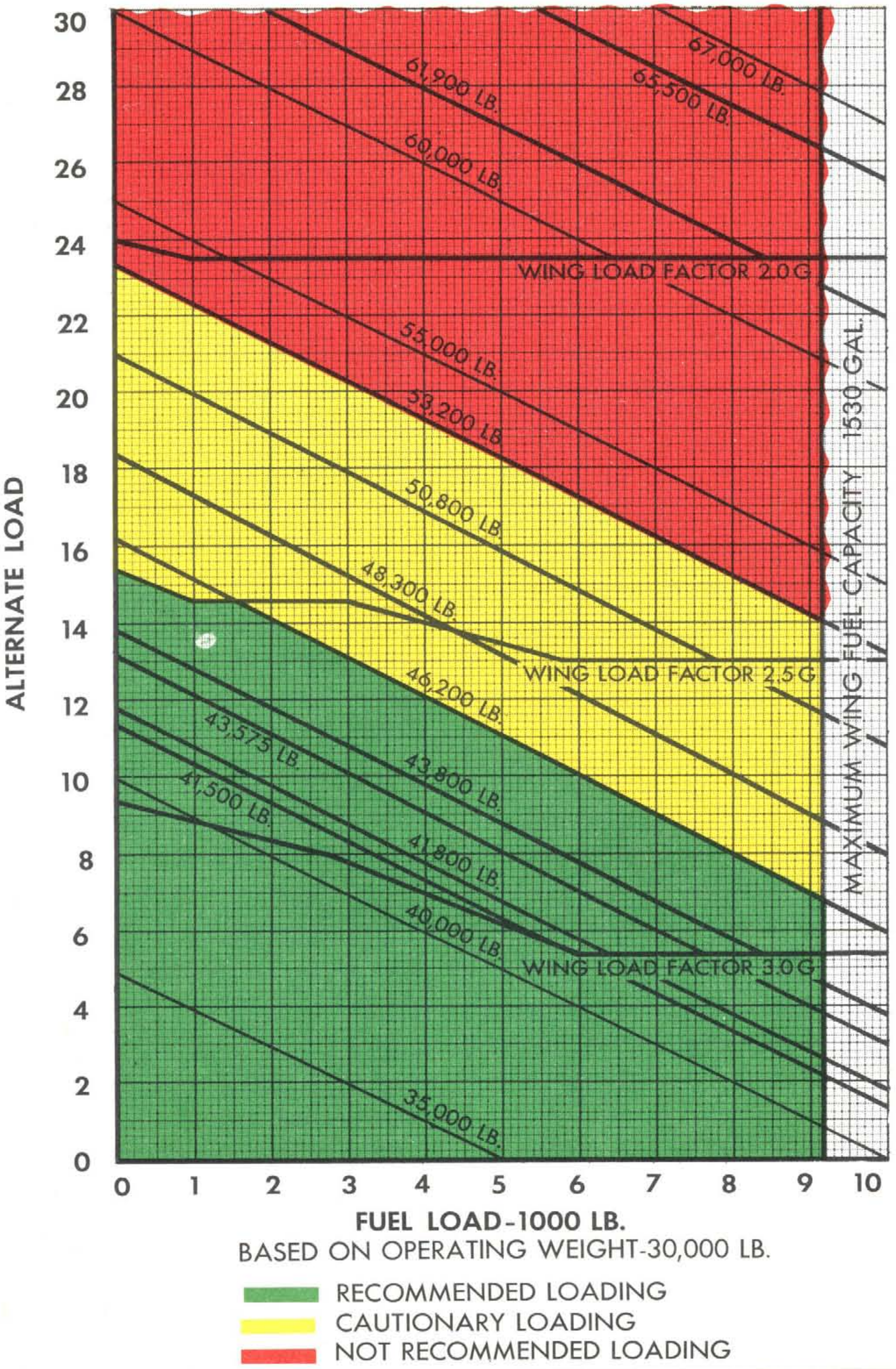


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Figure 5-4

CHART

41,500 lb	Maximum landing weight at 10 ft/sec sinking speed.
41,800 lb	100 ft/min rate of climb with wing flaps set at 24° (take-off), sea level, hot day, one engine inoperative, propeller feathered, and gear up, one engine operating at maximum dry power.
43,575 lb	Design gross weight.
43,800 lb	100 ft/min rate of climb with wing flaps set at 24° (take-off), sea level, standard day, one engine inoperative, propeller feathered, and gear up, one engine operating at maximum dry power.
46,200 lb	100 ft/min rate of climb with wing flaps set at 12° (take-off), sea level, hot day, one engine inoperative, propeller feathered, gear up, one engine operating at maximum dry power.
48,300 lb	100 ft/min rate of climb with wing flaps set at 12° (take-off), sea level, standard day, one engine inoperative, propeller feathered, gear up, one engine operating at maximum dry power.
50,800 lb	100 ft/min rate of climb with wing flaps set at 0° (take-off), sea level, hot day, one engine inoperative, propeller feathered, gear up, one engine operating at maximum dry power.
53,200 lb	100 ft/min rate of climb, sea level, standard day, one engine inoperative, propeller feathered, gear and flaps up, one engine operating at maximum dry power.
61,900 lb	Take-off ground run of 8000 ft sea level, standard day, flaps set at 0° (take-off), maximum wet power, two engines.
65,500 lb	500 ft/min rate of climb, sea level, standard day, gear and flaps up, METO power, two engines.
67,000 lb	Take-off ground run of 8000 ft, sea level, standard day, flaps set at 12° (take-off), maximum wet power, two engines.

NOTE:

The Weight Limitation chart is intended as a guide only. For specific performance limits based on existing atmospheric conditions, refer to Appendix I.

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Cautionary Loading Area

The yellow area on the weight limitation chart (figure 5-4) represents loadings of progressively increasing risk as the red area is approached. Caution must be exercised because single-engine performance is marginal depending upon configuration, altitude, and air temperature. This area is defined by the gross weight diagonal which indicates a rate-of-climb of 100 fpm at sea level on a standard day with one propeller feathered, gear and flaps up, and maximum dry power on the operating engine.

Not Recommended Loading Area

The red area on the weight limitation chart (figure 5-4), represents loadings which are not recommended because the margin of safety from the standpoint of both performance and structural limitations is less than the most desirable or the best practical. Under conditions of extreme emergency when safety of flight is of secondary importance, the commander will determine if the degree of risk warrants operation of the airplane at gross weights within the red zone.

USING THE WEIGHT LIMITATION CHART

For illustrative purposes, two sample problems follow:

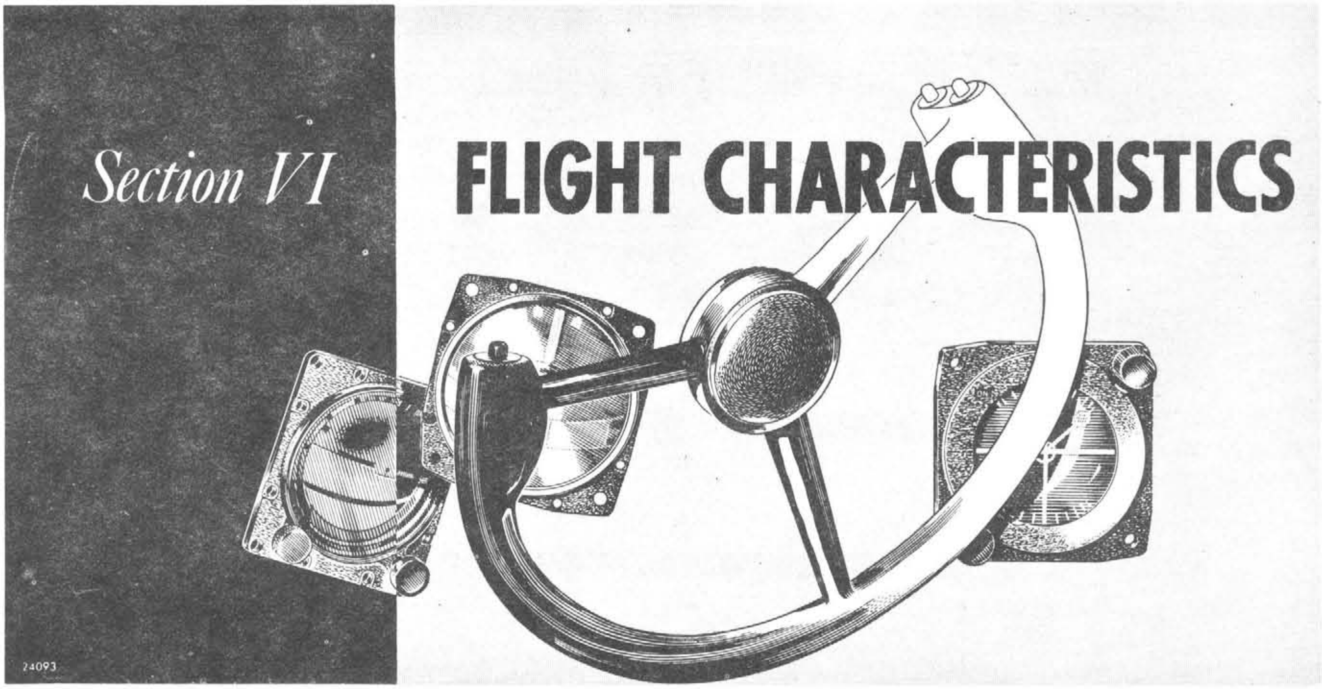
1. Assume a mission calls for a 5500-pound alternate load and 8500 pounds of fuel. Starting with the operating weight of 30,000 pounds at zero, proceed along the vertical alternate load axis to 5500 pounds; this increases the gross weight to 35,500 pounds. Next proceed along the horizontal fuel load axis to 8500 pounds and project a line vertically to intersect the horizontal projection of the 5500 pound alternate load line. By interpolation, the intersection will indicate a gross weight of 44,000 pounds. This loading falls within the area where it is recommended that a wing flap setting of 15° or less be used to assure positive performance in the event of engine failure during takeoff.

Note

For practical operation, the selection of takeoff flap setting should be limited to either 24°, 12°, 6°, or 0°. Intermediate positions should be used only when one of these flap settings will not provide the required initial rate of climb and runway length combination as shown in the Appendix.

2. Another example to demonstrate a problem when the operating weight of the airplane is different than that shown on the chart; assume an operating weight of 31,000 pounds instead of 30,000 pounds. It can be assumed that this increased weight is contained in the fuselage. Using the same requirements as in the previous example and proceeding as before, the gross weight will be found to be 44,000 pounds by interpolation. But to this weight, 1000 pounds must be added to the vertical axis to correct the chart for the heavy airplane. This increases the gross weight to 45,000 pounds. This loading falls within the same performance area as in the first example. However, if it is desired to maintain the same structural margin of safety, the alternate load must be reduced.

Section VI FLIGHT CHARACTERISTICS



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INTRODUCTION

This airplane has no unusual flight characteristics.

STALLS

STALL CHARACTERISTICS

There are no unfavorable stall characteristics. Ample stall warning in the form of tail buffeting is given in the approach to the stall. If proper stall recovery technique is used, very little altitude will be lost during the recovery. Power-off stall speeds for level flight and banked turns are given in figure 6-1.

PRE-STALL BUFFET

Buffeting is caused by a "burbled" or distorted airflow over airfoil surfaces. The pre-stall warning is primarily evidenced by moderate airplane and control system buffet or shake and secondly by a change in elevator control characteristics. The changes in elevator control characteristics at the onset of the pre-stall buffet are such that considerable elevator position and force changes are necessary for completion of the stall. Airplane buffet is the best indication of proximity to the stall.

Note

Mild buffeting, which may be mistaken for the pre-stall warning buffet, can be induced by sludge, ice, or mud on surfaces of the airplane, dirty wing and tail surfaces, or excessive nacelle flap openings. To keep drag and buffeting to a minimum, nacelle flaps should not be opened past midposition during flight.

POWER-OFF STALL CHART

GROSS WEIGHT-LB	DEGREES OF BANK	GEAR UP INDICATED AIRSPEED-KNOTS WING FLAP POSITION-DEG.						GEAR DOWN INDICATED AIRSPEED-KNOTS WING FLAP POSITION-DEG.					
		0	12	15	20	28	39	0	12	15	20	28	39
34000	0	95	89	88	86	83	80	93	87	86	85	82	80
	15	97	91	89	87	84	81	94	88	87	86	83	81
	30	101	95	93	91	88	84	98	93	91	89	87	84
36000	0	98	91	90	88	85	82	95	89	88	86	84	81
	15	99	93	91	89	86	83	96	90	89	88	85	82
	30	104	97	96	93	90	86	100	95	93	92	89	85
38000	0	100	93	92	90	87	83	97	91	90	88	86	83
	15	101	95	93	91	88	84	98	92	92	89	87	84
	30	106	99	98	95	92	88	103	97	96	93	91	87
40000	0	102	95	94	92	88	85	99	93	92	90	87	84
	15	104	97	95	93	90	86	100	94	93	91	88	85
	30	109	101	100	97	94	90	105	99	98	96	92	89
42000	0	104	97	96	93	90	87	101	95	94	92	89	86
	15	106	99	97	95	91	88	102	96	95	93	90	87
	30	112	104	102	99	96	92	107	101	100	97	94	91
44000	0	107	99	98	95	92	88	103	97	96	93	91	87
	15	108	101	99	97	93	89	105	98	97	95	92	88
	30	114	106	104	101	98	93	110	103	102	99	96	92
46000	0	109	101	100	97	93	90	105	99	98	95	92	89
	15	111	103	101	98	95	91	107	100	99	97	93	90
	30	117	108	106	103	99	95	112	105	104	101	98	94

24094

Figure 6-1

If buffet is encountered while flying at cruise altitude, speed should be recovered by increasing power and lowering the nose until safe flying speed is established. In this case, when buffeting is encountered, an increase in airspeed of 10 to 20 knots above the speed at which buffet commenced will be required to eliminate the condition. If buffeting is encountered during low-altitude flight, a small extension of wing flaps and an increase in power will usually eliminate buffet. After buffet has been eliminated, the wing flaps may be retracted in increments as speed is increased.

POWER-ON STALLS

Power-on stalls will be preceded by a buffet warning which will occur approximately 13 knots above the stall speed with the airplane clean, and four to five knots above the stall speed with full wing flaps. In some cases with the airplane at low gross weights without power, and in any weight configuration with power, a minimum control speed will be experienced before the actual stall. In this case the airplane will begin to turn and may roll during the stall. The roll is controllable, however. In most cases the airplane will stall and breakaway clean.

POWER-OFF STALLS

Power-off stalls are very mild with no tendency to fall off; ailerons and rudder remain effective.

ACCELERATED STALLS

Accelerated stalls are caused by raising the stall speed due to imposing more than the normal pull of gravity on the airplane. This can be done by centrifugal force in a turn or an abrupt pullout from a dive. The stall speed is increased by the square root of the g factor involved multiplied by the normal stalling speed. The airplane gives pronounced stall warning in the form of tail buffeting when this occurs. The secondary stall warning and buffet can be demonstrated in turns by applying excessive back pressure on the control column.

STALL RECOVERY

Use normal stall recovery technique. Permit the airspeed to build up through the buffet range, then start a normal recovery to level flight. If recovery is too abrupt, a secondary stall warning buffet may occur.

SPINS

Intentional spins are prohibited. If a spin should be entered accidentally, normal recovery procedure for two-engine airplanes is recommended, namely, power on the inside engine, opposite rudder, and elevator control for nose-down.

FLIGHT CONTROLS

Aileron, elevator, rudder, and trim tab controls are normal throughout slow, cruising, and high-speed flight. Controls become more sensitive as the speed increases; likewise, control forces become higher by the normal amount.

LEVEL FLIGHT CHARACTERISTICS

The airplane is stable under all normal flight conditions. The rudder is extremely sensitive under cruise conditions. Turns can be made with the aileron controls alone, due to the aileron-rudder interconnect device.

MANEUVERING FLIGHT

Maneuvering flight within the category of acrobatics is prohibited. Normal maneuvers may be accomplished with moderate effort. Flight tabs on the rudder and left elevator make control forces relatively light. In a tight turn, control forces are normal. There are no conditions of normal maneuvering flight which will produce a reversal of control pressure.

DIVING

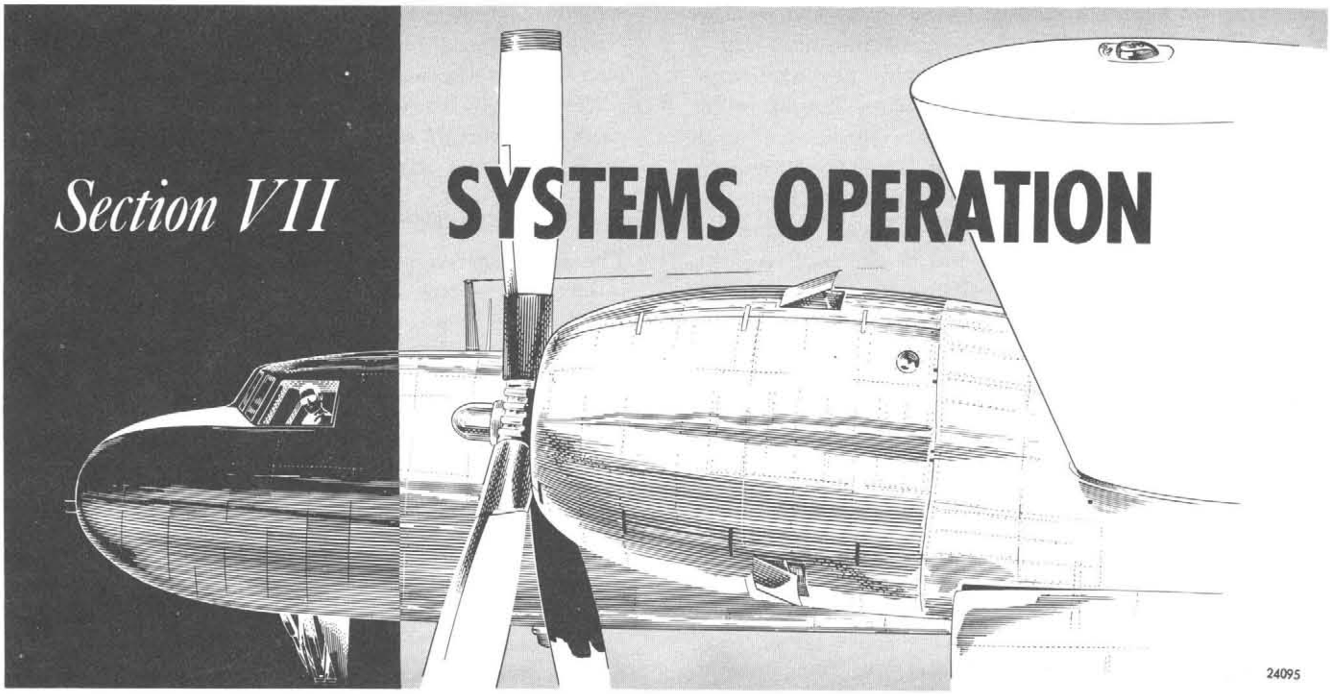
Use normal recovery methods from a dive. Do not exceed maximum dive speeds (figure 5-3).

LANDING

The proper use of power to control the rate of descent during approach and landing operations is important. Cutting the power at low airspeeds results in abrupt deceleration due to the large increase in drag caused by windmilling propellers and extended flaps. To maintain lift in this condition, speed must be maintained. The only way to keep speed is to lower the nose of the airplane. This results in a drastic increase in the rate of descent. Safe landings can be made by maintaining some power throughout the approach and then retarding throttles to the stops during the flareout, just prior to touchdown. Immediately after touchdown, the wing flaps may be retracted to let the weight of the airplane rest entirely on the wheels for a more positive brake effect, and the throttles may be pulled back into the reverse thrust range for aerodynamic braking. Landing field lengths shown in the Appendix are based on the use of brakes only. Efficient use of reverse thrust will shorten the landing roll appreciably.

Section VII

SYSTEMS OPERATION



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LANDING GEAR SAFETY CIRCUIT 7-10

ENGINE

Engine installation on the airplane differs from the usual installation in the use of augmentors extending from just forward of the engine firewall aft through the nacelle to the wing trailing edge. Five of the ten exhaust stack outlets of the engine extend to the forward end of each augmentor. Open space remains between the exhaust stacks and the mouth of the augmentor. When the engine is operating, exhaust gas is ejected from the stacks into the augmentors. The force of the exhaust creates a partial vacuum at the mouth of each augmentor, causing air that has entered the engine section around the propeller hub to rush into the augmentors. This action continuously draws cooling air across the engine. The cooling effect, although not necessarily the maximum cooling possible, is most uniform when the engine area is not subjected to the diverting flow caused by open nacelle flaps. The pump action of the high velocity exhaust gases through the augmentors gives a jet thrust effect as the mixture is forced out of the aft ends of the augmentors. This thrust is considered to be sufficient at low airspeeds and high power settings to provide some positive thrust power. At moderately high airspeeds and lower power settings, the thrust is considered to be sufficient at least to nullify cooling drag. Perhaps the main advantage of the augmentor installation is in flow of cooling air over the engine. The cooling air is automatically proportioned to the power setting at all times due to the aspirating effect of the exhaust gases. Another important advantage is that with this system the cumbersome ring of conventional cowl flaps around each nacelle is eliminated. Four adjustable nacelle flaps are located in each nacelle. The flaps are opened on the ground to allow heat to escape from the engines. To control cylinder head temperature in flight, the flaps are used in the same manner as cowl flaps. The augmentors conduct considerable heat that is used to provide heating air for the cabin heat exchanger and the wing and tail anti-icing systems. A tube larger than the augmentor is installed as a sleeve over each augmentor. The forward end of the tube is open and air flows into it under moderate ram pressure from the engine section when the airplane is in flight. A muff collects the heating air at the aft end of the tube. A duct, joined to the muff by a heat valve, leads the heating air to the appropriate system. The inboard augmentor in each nacelle heats air for the cabin heat exchanger and for tail anti-icing. The outboard augmentor in each nacelle heats air for wing anti-icing. The temperature to which the air will be heated depends on airspeed, engine power setting, position of the nacelle flaps, and position of the augmentor vanes. The cylinder head temperature gages and the anti-icing temperature gages for the wing and tail leading edges provide the best indication of the heating air temperatures. Use of the augmentors as a source of heating air eliminates the need for combustion heaters or electrical heat sources for cabin temperature control and wing and tail anti-icing.

CYLINDER HEAD TEMPERATURE CONSIDERATIONS

Normally, cylinder head temperature control is maintained by use of the nacelle flaps. During wing and tail anti-icing operation, vanes in the augmentors provide a means of restricting exhaust flow through the augmentors in order to raise the temperature of heated air for anti-icing operation. When the vanes are closed they restrict the flow of cooling air and exhaust gases through the augmentors. This reduced airflow results in a smaller volume of cooling air passing around the engines, and thus increases cylinder head temperatures.

ENGINE TORQUEMETERS

Engine torquemeters (39, figure 1-7) are provided to indicate the power being delivered to the propellers. The indicators are sensitive instruments indicating torque in psi. They are energized electrically by torque pressure transmitters installed on the aft accessory section of the engines. The torquemeter circuit is powered by 26-volt regulated ac power. The torque indication is originated by a master torque pressure piston and five subsidiary pistons installed in the forward accessory section of the engine in such a way that when power is transmitted to the propeller from the engine, the fixed reduction gear mounted on a spirally spindle shaft tends to move forward on the splines. The forward face of the gear pushes against the pistons, creating a pressure on oil supplied at the other end of the piston by the oil pressure boost pump. This develops pressure through a static fluid tube against torque pressure plates which actuate the torque pressure transmitters. The torque indicated on the torquemeter is therefore the torque applied to the propeller. Power delivered to auxiliary equipment and electrical equipment by the engine is not included in the torquemeter indication. The indicated torque of the two engines will not necessarily be equal at any time, partly due to possible variation in accessory load and engine condition, but also because the tolerances of the installations are such as to allow a possible difference of five psi or more. The torque constant is 0.00632. BHP may be calculated by using the following formula:

$$\text{BHP} = \text{Torque (psi)} \times \text{Torque Constant} \times \text{RPM}$$

The torquemeters provide the best indication of power failure and power changes. If a carburetor should ice, the decrease in power as shown on the torquemeter will usually be the first indication. If spark plugs begin to fail, or other failure begins, this power loss will be indicated by the torquemeter. Torque pressure will drop if the carburetor begins to ice, if fuel pressure fluctuates or drops below operating limits, if the ignition system is defective, or if cylinder head temperatures are too high and the mixture too lean. In general, any condition which prevents the engine from developing all of the power it should develop at a given power setting will be reflected in abnormally low torque pressure indication. Refer to CARBURETOR MIXTURES, this Section, for use of torque pressure indication for manual leaning.

DETONATION

Detonation is one of the principal hazards associated with the operation of a high output engine. It is the result of sudden exploding of the charge in the combustion chamber as contrasted to the steady release of energy in the progressive and relatively slow burning which occurs during normal combustion. Detonation is accomplished by severe pressure waves in the combustion chamber. Abnormal heat is developed. Damage to the engine will result from continuous or frequent detonation and in the worst instances detonation leads rapidly to complete engine failure. Detonation as in an automobile engine can be heard as a sharp knocking. If other sounds could be filtered out, knocking would be audible in an airplane engine in which detonation was occurring. A rapid increase in cylinder head temperature, however, is the only warning of detonation. The following factors contribute to the tendency of an engine to detonate: (1) excessive manifold pressure; (2) insufficient cooling; (3) lean fuel-air mixtures; (4) excessive carburetor air temperatures; (5) faulty ignition system; and (6) fuel of low anti-knock (octane) value. The first four of these factors can be controlled from the flight compartment. If engines are operated within the specified limits, on the recommended grade of fuel, and with carburetor and ignition systems in normal condition, there will be no detonation.

WATER (ANTI-DETONANT) INJECTION

As explained in DETONATION, this Section, engine operation at excessive manifold pressures and insufficient cooling contributes to detonation. In the absence of water injection, the tendency to detonate at high power settings is suppressed by enriching the mixture beyond the best power fuel-air ratio to supply excess fuel for cooling. When water injection is used, the fuel-air ratio is automatically deriched to the best power range and a water-alcohol solution is introduced with the fuel entering the engine, to provide charge cooling and prevent detonation. This ability to operate safely in the high power range with best power mixtures provides more brake horsepower for a given throttle and RPM setting than would otherwise be available with the rich mixtures accompanying operation without water injection.

Note

> The manifold pressure limit for operation without water injection is higher than the limiting pressure with water injection (when using grade 115/145 fuel). This apparent discrepancy is explained by the preceding paragraph. An excess of fuel allows the use of high manifold pressure; however, power output level is low due to the rich mixture.

The consumption of ADI fluid at takeoff power (2500 BHP) is approximately 1.5 gallons per minute for each engine. Considering the usable tank capacity of 22 gallons, there is sufficient fluid to operate both engines for approximately seven minutes or one engine for 14 minutes.

THROTTLE OPERATION

Power changes should be made smoothly and gradually. If throttles are jerked or moved rapidly, backfiring and torching may result.

ENGINE BLOWERS

ENGINE BLOWER SHIFT CHECK

When making an engine blower shift check, pilots should make absolutely certain that blowers are back in low before takeoff. Should the blower shift actuator fail to shift from high back to low, and a takeoff be made in high blower, severe detonation caused by high compression and high temperature of the mixture might result in engine failure. To determine whether or not blowers have actually shifted, pilots may observe two indications: manifold pressure and oil pressure. When shifting from high back to low, an approximate two-inch drop in manifold pressure and a fluctuation of oil pressure indicate that the blower has actually gone back into low position.

ENGINE BLOWER SHIFT OPERATION

Two factors govern engine blower shifting – altitude, and carburetor air temperatures. The altitudes for shifting blowers are given in the Power Schedule Tables in the Appendix. These altitude values are determined from engine operating curves and comparative fuel consumption for each blower ratio at the same engine power output. They are based on use of low blower whenever the desired power can be maintained at the selected rpm with full throttle. Carburetor air temperature as related to blower operation is of critical importance. Carburetor air temperature is measured before fuel is injected and before the fuel-air mixture passes into the blower section. Due to the compressor action of the blower and other factors, considerable heat rise occurs in the fuel-air mixture before the charge is admitted to the cylinders. By controlling the carburetor air temperature to certain maximums, it is therefore possible to preclude detonation that originates from excessive carburetor heat. The low blower critical altitude (full throttle) for normal climb BHP is usually reached in the range of 12,000 to 15,000 feet, depending upon existing atmospheric conditions and variations in engine condition. Use the following procedures when shifting from low to high blower to maintain the same condition of rpm and manifold pressure:

1. After passing the low blower critical altitude, continue full throttle climb until manifold pressure falls off five inches Hg.
2. Set throttle to reduce manifold pressure an additional four inches Hg.
3. Place blower switch in HIGH position.
4. Set throttle to obtain desired manifold pressure.

CAUTION

- Do not shift to high blower if carburetor air temperature exceeds limits. High blower operation above these temperature ranges will then cause excessively high mixture temperature with resulting detonation.
- In the event electrical power is lost or temporarily disrupted during high blower operation, the blowers will automatically shift to the low ratio. To prevent inadvertent shift back to high blower, place the blower switches in LOW position before restoring power. Refer to ELECTRICAL POWER SUPPLY SYSTEM EMERGENCY OPERATION, Section III.

If the power desired for use with high blower is lower than that for low blower, shift to high blower when the manifold pressure falls to the value desired. During climb, watch cylinder head temperatures and do not exceed maximum permissible temperature. Maintain 200°C or less, opening nacelle flaps and increasing airspeed for better cooling.

CARBURETORS

CARBURETOR AIR TEMPERATURE

The engines on this airplane require two different carburetor air temperature limits, one for low and one for high blower operation. Because of the higher temperature rise in the blower when operating in high ratio, carburetor heat must be held to a lower temperature. If this is not done, detonation will occur. For high blower carburetor heat limits, refer to ENGINE LIMITATIONS, Section V. While eliminating ice from the carburetors these limits, of course, do not apply since this is considered an emergency situation of short duration.

CARBURETOR MIXTURES

The carburetor used on the R2800-99W engine permits manual leaning of the fuel-air mixture strength for decreased fuel consumption and increased range. The manual mixture control mechanism of the carburetor provides a wide angle of adjustment between the AUTO RICH position and the IDLE CUTOFF position. This allows a closer, more accurate adjustment of the mixture ratio. Mixture strength may be adjusted manually, if desired, on the basis of torque oil pressure drop from the best power position.

MANUAL LEANING

As automatic carburetor operation will not permit the attainment of maximum precision in the control of fuel flow and mixture strength, and since the AUTO LEAN mixture position is set to assure smooth engine operation rather than fuel economy, some method of manually leaning the cruise mixture is desirable. Basically, the manual leaning procedures outlined below provide for establishing the desired fuel-air ratio with as many factors as possible held constant, including airflow, cylinder head temperature, carburetor air temperature, manifold pressure, and rpm. Only fuel flow is varied and the resulting changes in power follow closely the fundamental relationship existing between the fuel-air ratio and power. The following procedures for manually leaning the cruise mixture and setting up economical fuel flows are based on a torque pressure drop from the best power condition.

During Climb

Prior to reaching cruising altitude, determine the brake horsepower required to obtain the desired performance. Refer to the power schedule charts in the Appendix.

Note

For prolonged engine durability, it is recommended that 1200 BHP or less be used for normal cruise.

Cruise

After climbing to the desired cruising altitude, accelerate to cruising speed. As airspeed increases, adjust nacelle flaps to establish cylinder head temperature at desired value for cruise.

1. Mixture control in AUTO RICH.
2. Adjust manifold pressure and rpm to cruise settings as obtained from power schedule charts in the Appendix.

CAUTION

- Manual leaning is not permitted above 1200 BHP.
- When using alternate fuel grade 100/130, do not exceed 1100 BHP in high blower.

3. After three to five minutes to allow for stabilization, move the mixture control levers (one at a time) toward AUTO LEAN until a maximum torque oil pressure reading is obtained. This is the best power mixture setting. Note the pressure.

Note

Due to manufacturing and maintenance tolerances, the best power position of the mixture control levers will vary from engine to engine and airplane to airplane. The position may be found at the AUTO RICH position or in a range of travel from AUTO RICH to a point slightly above AUTO LEAN position.

4. If the best power peak cannot be determined or if the AUTO RICH position is thought to be leaner than the best power it may be necessary to use prime to establish the setting. When prime is applied with mixture control in AUTO RICH, the following relationships apply, as shown in figure 7-1.

Note

Engage the engine primer and watch the torque oil pressure gage for a rise, drop, or steady indication. Note the maximum torque oil pressure reading and then disengage the primer.

   a. If torque oil pressure drops, AUTO RICH is at or richer than best power; if it is richer than best power, the torque oil pressure will rise as the maximum is manually leaned from AUTO RICH (figure 7-1, condition 1).
   b. If the torque oil pressure does not change, AUTO RICH is near the lean end of the best power mixture range (figure 7-1, condition 2).
   c. If the torque oil pressure rises, or rises and then falls, AUTO RICH is leaner than best power (figure 7-1, conditions 3 or 4).

5. After establishing the best power mixture setting, check the manifold pressure. If the resulting manifold pressure exceeds the maximum value, retard the throttle to the limiting value.
6. Further retard the mixture control until the desired torque pressure drop from the peak value is obtained.

7. Periodically check to see that the specified manifold pressure and torque pressure drop is maintained. The torque pressure drop may be checked by energizing the primer and checking the specified TPSI rise to the best power peak.

This procedure of setting power places final reliance upon the manifold pressure gages and tachometers, but uses the torquemeter as a primary power setting instrument within limits. Further, the torquemeters are the primary instruments for setting cruise power mixtures. This method of setting cruise mixtures by a given torque pressure drop from best power will generally provide a power setting that is optimum for cruise powers. However, if the AUTO RICH setting is excessively lean (figure 7-1, condition 4), this drop could result in a setting of less than best economy which might result in unsatisfactory engine operation. If any evidence of engine leanness (such as engine roughness, surging and/or a low cylinder head temperature) is encountered, place the mixture control in AUTO LEAN to attain smooth operation.

CHANGE TO POWER SETTINGS

Whenever changes are made to the power settings, it is advisable to check that the resulting torque pressure is the specified amount below the maximum reading. Under most conditions, a one-inch change in manifold pressure or a 100 rpm change will not appreciably affect the relative mixture setting. However, since a change in airspeed, altitude or temperature may affect the metering characteristics of the carburetors, the mixture settings should be periodically checked enroute to ascertain that the torque pressure drop is the correct amount below the maximum reading.

MANUAL MIXTURE ADJUSTMENT

During cruise operation above 1200 bhp in low blower, manual mixture adjustment to minimum fuel flow is used instead of manual leaning to torque pressure drop. The procedure for manual adjusting of the mixture controls is as follows:

1. Set rpm and manifold pressure for desired power.
2. Manually adjust the mixture control levers to minimum fuel flow as specified on the fuel flow charts in the Appendix.

CAUTION

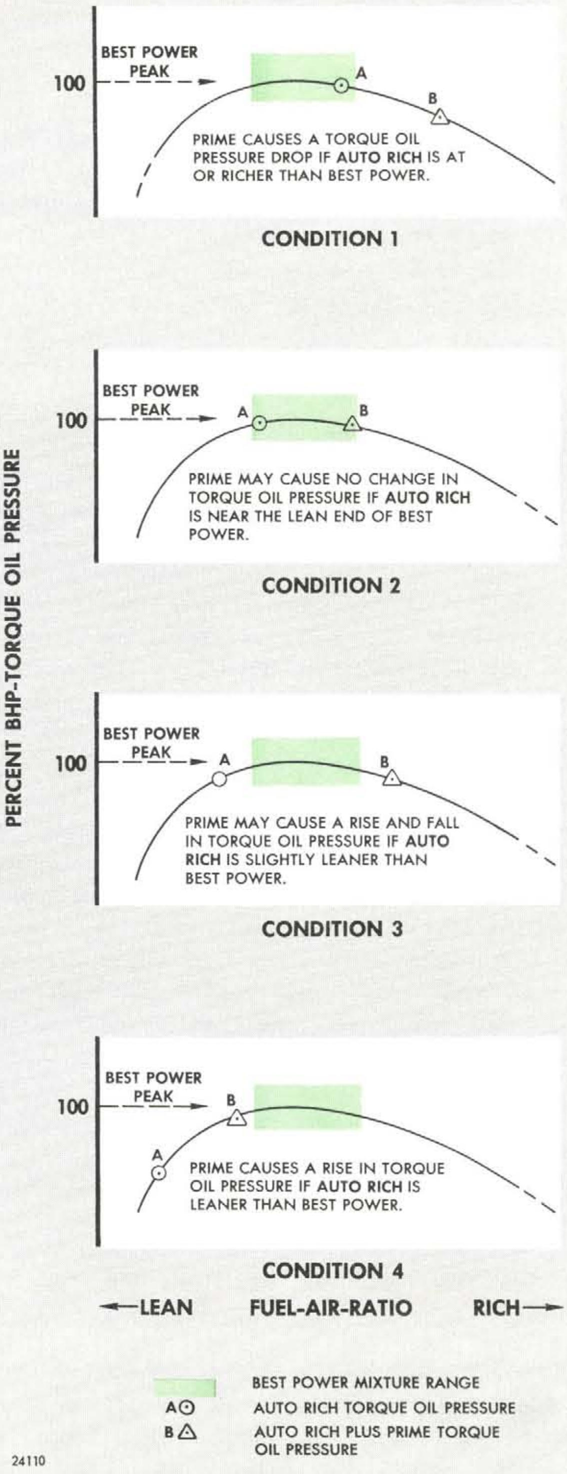
Engine roughness, detonation, and loss of power will result if fuel flow is below the minimum for the desired power setting.

CARBURETOR ICING

Note

If carburetor icing conditions are anticipated, apply carburetor heat to maintain the limits for continuous operation. *The use of carburetor*

EFFECT OF PRIME ON POWER AT VARIOUS AUTO RICH MIXTURES



PRIME CAUSES A TORQUE OIL PRESSURE DROP IF **AUTO RICH** IS AT OR RICHER THAN BEST POWER.

CONDITION 1

PRIME MAY CAUSE NO CHANGE IN TORQUE OIL PRESSURE IF **AUTO RICH** IS NEAR THE LEAN END OF BEST POWER.

CONDITION 2

PRIME MAY CAUSE A RISE AND FALL IN TORQUE OIL PRESSURE IF **AUTO RICH** IS SLIGHTLY LEANER THAN BEST POWER.

CONDITION 3

PRIME CAUSES A RISE IN TORQUE OIL PRESSURE IF **AUTO RICH** IS LEANER THAN BEST POWER.

CONDITION 4

Figure-7-1

heat for prevention of ice and loss of power when in high-moisture atmosphere is most effective if applied and maintained in advance of encountering these conditions. Carburetor heat should be used when carburetor air temperature is −10°C to +15°C and weather conditions are conducive to carburetor icing, or when carburetor air temperature is below −10°C and poor fuel vaporization and distribution is indicated by engine roughness or loss of power.

Loss of power while flying through visible moisture conditions or at near-freezing temperature is usually due to carburetor ice. Indications of carburetor icing generally appear in the following order:

1. Change in torque pressure.
2. Change in fuel flow.
3. Surging or misfiring.
4. Change in cylinder head temperature.
5. Oscillation of rpm and manifold pressure.

If ice accretion is allowed to progress to a critical extent, loss of power may make it impossible to generate sufficient heat to clear the engine. The use of carburetor heat has the disadvantage of reducing ram pressure rise of the inlet air, thus reducing engine critical altitude and causing premature shift to high blower operation. This results in a loss of supercharger efficiency and decreases the power available for a constant manifold pressure. If torque pressure, manifold pressure, or fuel flow unaccountably change, carburetor icing may be the cause. Apply heat for a short period of time; this will result in a further manifold pressure reduction but if a subsequent slow rise is noted in manifold pressure, ice is present and is melting. In this event, continue applying carburetor heat until icing conditions no longer prevail. Manifold pressure and cylinder head temperature should be monitored closely during this period. If high blower is used during carburetor anti-icing, rpm and manifold pressure must be adjusted to cruising values as specified in the cruise charts in the Appendix. If it is suspected that ice has already formed in the carburetor, apply full carburetor heat and maintain it for 30 seconds. Then slowly move the carburetor heat levers toward the COLD position to see if manifold pressure and torque pressure have been restored to nearly their former indications. Maintain carburetor heat as long as required to eliminate the ice.

Engine Stoppage Due to Carburetor Ice

If, during flight, the carburetor has iced up to the extent that the engine stops, actuate the prime switch. The primer will provide enough fuel to restart the engine. After the engine starts, use full carburetor heat until carburetor has de-iced and engine will operate normally.

Note

> A slight loss in power usually continues after use of carburetor heat. Five minutes may be required before normal power is restored if the mixture control lever is left in a lean position. To restore power most quickly, place mixture control lever in AUTO RICH.

Sometimes, when the temperature of the fuel is below freezing and icing conditions are present, another type of carburetor icing occurs. This is the formation of ice plugging the mixture control bleeds in the regulator section of the carburetor. This sort of icing is indicated by an appreciable increase in fuel flow and a change in TPSI. To remedy this situation, use maximum permissible carburetor heat and manually lean to original fuel flow. Adjust mixture to original fuel flow as ice is dissipated.

SUB-TEMPERATURE OPERATION

Operation at carburetor air temperatures below −10°C must not be avoided because of fear of formation of excessive lead deposits. This engine will operate entirely satisfactorily with carburetor air temperature as low as −55°C. The lowest carburetor air temperature at which this engine will operate satisfactorily depends on its condition and the ability of maintaining warm cylinder head temperatures of approximately 200°C.

IGNITION SYSTEM

SPARK PLUG FOULING AND LEADING

Spark plug fouling is a principal cause of ignition trouble, which in turn is one of the most common engine maintenance and operating problems with airplane engines using 115/145 or 100/130 grade fuel. These grades of fuel may contain a relatively high lead content. Such fouling might be defined as an accumulation of deposits which cause misfiring or prevent firing across the spark plug electrodes. The most common types of fouling are lead fouling and carbon fouling, with lead fouling the main trouble-maker. Cause, prevention, and cure of spark plug fouling are all linked to the chemistry and physics of the combustion cycle, which in turn are subject to wide variation under different ground and flight engine operating conditions. A logical treatment of the problem involves separate discussion of each aspect of typical engine operation including ground running, takeoff, climb, cruise, and descent. Prevention appears to be the most profitable line of attack on the problem.

IMPORTANT FACTORS

Tetraethyl lead is the most important basic cause of lead fouling. Scavenger agents such as bromine in the tetraethyl lead are provided to combine with the lead during combustion, thereby removing the lead with the exhaust gases. However, under certain conditions of temperature and pressure, the lead will condense on the spark plug insulator as lead oxide or lead bromide. In the presence of excess carbon as a reducing agent, these may form metallic lead particles. All such deposits can prevent ignition or firing. Obviously the best solution is to remove or reduce the lead compounds presently contaminating the fuels. Other pertinent factors which influence plug misfiring include the type of ignition system, spark plug characteristics and length of time in operation, water injection operation (dry or wet takeoffs), general engine conditioning including the care and handling of spark plugs, the operating requirements and characteristics of the particular engine installation, and the specific engine operating conditions. In general, spark plug fouling involves a buildup of deposits through prolonged operation under a fixed set of conditions. Prevention and remedy for plug fouling, therefore, depend on taking action to vary these conditions, thereby upsetting the chemistry of the fouling cycle, to restore good ignition.

GROUND RUNNING

Prolonged periods of idling may lead to fouling of the spark plugs. "Clearing out" of the engine at ten-minute intervals is recommended. This should be done by running the engine up to field barometric pressure manifold pressure (indicated by manifold pressure gage reading before starting) for one minute after each ten minutes of idling. This is particularly pertinent during extended idling while awaiting runway clearance before takeoff. If an engine analyzer is aboard, ignition analysis and vibration analysis checks should be performed at field barometric manifold pressure.

Note

> If unacceptable spark plug performance is experienced, place mixture in AUTO RICH. Move throttles to 35 inches hg., then move mixture to AUTO LEAN and allow cylinder head temperature to reach 160°C and hold for 30 seconds. Move mixture control to AUTO RICH. If engine power check is not satisfactory, repeat the above procedure. In event a second attempt to clear spark plugs fails to produce satisfactory results, do not attempt to take off.

TAKEOFF

Smooth and steady application of the throttle is preferable to a rapid or "jam" acceleration to takeoff power. The most common symptoms of spark plug fouling include erratic torque pressure readings, loss of torque pressure, and associated backfiring and rough running; all of these are evidence of advanced stages of misfiring. When these symptoms develop reduce manifold pressure as required to restore smooth operation. Turn off the water injection to further reduce spark plug load and facilitate firing.

CRUISE

Type and Cause of Fouling

Cruise conditions usually generate lead fouling rather than carbon fouling. Conditions favorable to lead fouling include long-continued application of a given set of engine conditions typical of cruise flight, particularly those involving very lean mixtures. Associated contributing factors include abnormally cool cylinder head temperatures and low manifold pressure. Common symptoms include torquemeter oscillation and backfiring or afterfiring.

Prevention of Fouling

A periodic change in engine conditions will usually forestall lead fouling. Here again, prevention is preferable to cure. Hourly intervals are frequently used and may accomplish results either by use of AUTO RICH for five minutes, a change of three to five inches of manifold pressure, or a change of 100 to 300 rpm. A reduction in power followed by an increase appears to be the preferable approach to prevention. One or more of these procedures should prove effective, and the procedure which least affects the flight condition, and is least noticeable to passengers is naturally preferable.

Detection of Fouling

Keep the engine analyzer on at all times and perform checks at stabilized engine speeds. Ignition analyses should be performed during initial climb, after cruise altitude is reached, and prior to descent. Vibration analyses should be performed at regular intervals during prolonged flight and at such other times considered necessary, based on engine instrument indications and other engine checks.

Cure of Fouling

Cure is less certain and includes a wider variety of procedures than prevention. If fouling is detected soon enough, however, it can usually be eliminated or held to a minimum by a sharp increase in combustion temperature. A sharp rise in combustion temperature can be obtained by going to METO power for a short period. Generally, plugs which are misfiring or completely fouled are apt to resume firing at lower power settings. Therefore, it is preferable to reduce power and then restore it, rather than attempt to reach a high power setting with malfunctioning plugs. High-power burnout procedures, with or without water, could chemically change the fouling deposits to an extent that there could be no inflight remedy and the only cure would be to change spark plugs. High-power burnout procedures also introduce the possibility of destructive backfiring during the application of power.

DESCENT

If a fouling problem is encountered in descent, it can usually be cured by clearing the engine during final approach—with flaps and gear down, approach rpm, and a high power level set for one to two minutes prior to landing. When the cylinder head temperatures are up to the cruise range, the plugs will usually be clear and ready for any possible high power requirement.

DESCENT POWER SETTING

Flying conditions permitting, adjust the throttle and/or propellers to maintain level flight cruise power during descent. If flying conditions in descent require a large reduction in power, reduce rpm as well as manifold pressure. For descents or other low power maneuvers it is important to cushion the high inertia loads on the master rod bearings which occur at conditions of high rpm and low manifold pressure. Avoid prolonged high rpm with low manifold pressure. Attempt to maintain a power setting of one inch Hg manifold pressure per 100 rpm. The engines cool rapidly during descent. Use the nacelle flaps and augmentor vanes to maintain cylinder head temperatures.

OIL SYSTEM

RESERVE OIL SYSTEM OPERATION

The engine oil tanks should be reserviced to 22 gallons when the oil tank quantity gage indicates between nine and 12 gallons during level flight. Reservicing should be started before the oil level in the engine tank falls to nine gallons. To transfer oil, place the function selector switch in the TRANSFER position and then hold the system operating switch in either the LH or RH position, as required. Release the switch to stop the transfer. After transferring oil, the oil line must be scavenged. Place the function selector switch in the PURGE position and hold the system operating switch in the LH or RH position, as required, to allow fuel to enter the oil transfer line through an auto-operated solivalve. Releasing the system operating switch to the OFF position stops the transfer pump and closes the oil transfer valve.

CAUTION

Purging of oil lines must be limited to a maximum of two minutes to prevent overdilution of the reserve oil.

FUEL SYSTEM

FUEL SYSTEM OPERATION

The fuel system is described in Section I. Additional information on operation of the fuel booster pumps and the crossfeed system in various unusual circumstances is provided in the following paragraphs. Refer to the Appendix for fuel consumption data.

FUEL BOOSTER PUMP OPERATION

In addition to using the booster pumps for starting, takeoff, climb, and landing, they should be used in flight whenever fuel pressure fluctuates within limits. Sometimes, at high altitudes or with high fuel temperatures, engines will surge because of vapor lock. This may be brought about by "boiling" of the fuel at high temperatures or at high altitudes after rapid climb. The characteristics of the condition are oscillation of fuel pressure and fuel flow, and flickering of the fuel pressure-low warning light. Booster pumps correct this trouble by decreasing the tendency of the fuel to vaporize in the lines, thus preventing fuel pump cavitation.

CAUTION

- With sufficient downward fluctuation of fuel pressure a power loss occurs. The propeller governor will turn the blades to flatter pitch in order to keep engine rpm up to the setting of the governor. If full fuel flow is then suddenly restored, the engine may tend to overspeed before the propeller can return to higher pitch. Proper fuel booster pump operation will prevent this.
- The fuel booster pump must not be turned on if fuel pressure drops below operational limits while the engine continues to operate normally. A fuel leak may be responsible for the pressure drop. Refer to Section III for instructions in this event.

FUEL CROSSFEED OPERATION

When operating on crossfeed, the main fuel shutoff valve switch for the tank not being used must be turned to OFF. Unless this is done, fuel may be inadvertently transferred from tank to tank.

WARNING

- Fuel must not be transferred intentionally from tank to tank. Should transfer take place, pressure might build up in a tank to the extent that fuel would overflow through the vents.
- Inadverent transfer may also take place if fuel booster relief valves are not equalized.

When operating on crossfeed to the opposite engine, or to both engines, the fuel booster pump of the tank being used must be turned on if fuel pressure drops or fluctuates below operating limits and abnormal engine operation is evident. The fuel shutoff valve for the tank not being used must be closed to preclude fuel transfer from tank to tank. During the changeover from normal to crossfeed operation, or from crossfeed back to normal, it is very important to maintain constant fuel pressure at all times. If pressure is allowed to drop during the changeover, its resurgence will cause high pressure in the fuel system which might damage the carburetor diaphragm. To prevent this, maintain constant fuel pressure by adhering to the sequence of steps in the following procedure:

Two-Engine Operation

1. Normal to Crossfeed:
    a. Place both booster pump switches in ON position.
    b. Position the crossfeed handle to OPEN.
    c. Place the booster pump switch for the unused tank in OFF position.
    d. Place the main fuel shutoff valve switch for the unused tank in OFF position.
2. Crossfeed to Normal:
    a. Place both booster pump switches in ON position.
    b. Place the main fuel shutoff valve switch for the unused tank in ON position.
    c. Turn the crossfeed handle to the OFF position.
    d. Position booster pump switches as required.

Single-Engine Operation

1. Normal to Crossfeed:
    a. Place both booster pump switches in the ON position.
    b. Place both main fuel shutoff valve switches in ON position.
    c. Turn the crossfeed handle to the OPEN position.
    d. Place the booster pump switch for the unused tank in OFF position.
    e. Place the main fuel shutoff valve switch for the unused tank in OFF position.
2. Crossfeed to Normal:
    a. Place the booster pump switch for the unused tank in ON position.
    b. Check that both main fuel shutoff valve switches are in ON position.
    c. Turn the crossfeed handle to the OFF position.
    d. Place booster pump switch and main fuel shutoff valve switch for the unused tank in the OFF positions.

USE OF BRAKES

Brakes, themselves, can merely stop the wheel from turning, but stopping the airplane is dependent on the friction of the tires on the runway. It has been found that optimum braking occurs with approximately a 15 to 20 percent rolling skid; i.e., the wheel continues to rotate but has approximately 15 to 20 percent slippage on the surface. As the amount of skid increases, friction decreases because the first immediate action is to scuff the rubber, tearing off little pieces which act almost like rollers under the tire. Then the heat generated starts to melt the rubber and the molten rubber acts as a lubricant. Therefore, if one wheel is locked during application of brakes, there is a very definite tendency for the airplane to turn away from that wheel, and further application of brake pressure will offer no corrective action. The following recommendations should be followed insofar as practicable:

1. Use extreme care when applying brakes immediately after touchdown, or at any time when there is considerable lift on the wings, to prevent excessive skidding of tires which will cause flat spots. A heavy brake pressure can result in locking the wheel more easily if brakes are applied immediately after touchdown than if the same pressure is applied after the full weight of the airplane is on the wheels. A wheel once locked in this manner immediately after touchdown will not become unlocked as the load is increased, as long as brake pressure is maintained. Proper braking action cannot be expected until the tires are carrying heavy loads.
2. The full landing roll and reverse thrust should be utilized to take advantage of aerodynamic braking and to use the brakes as little and as lightly as possible.
3. If maximum braking is required after touchdown, lift should be decreased as much as possible by raising the flaps and dropping the nose before applying brakes. This procedure will improve braking action by increasing the frictional force between the tires and the runway.
4. For short landing rolls, a single smooth application of the brakes with constantly increasing pedal pressure is most desirable. This procedure applies equally well for operation of the emergency braking system.
5. During a series of successive landings, a minimum of 15 minutes should elapse between landings where the landing gear remains in the slipstream, and a minimum of 30 minutes between landings with the landing gear retracted, to allow adequate cooling time between brake applications. This time restriction is not applicable to "touch-and-go" landings when no brake application is involved.
6. The brakes should not be dragged while taxiing, and should be used as little as possible for turning the airplane on the ground.
7. At the first indication of brake malfunction, or if the brakes are suspected to be in an overheated condition after excessive use, the airplane should

be maneuvered off the active runway and stopped. The airplane should not be taxied into a crowded parking area and the parking brakes should not be set. Overheated wheels and brakes shall be cooled before the airplane is subsequently towed or taxied. Peak temperatures in the wheel and brake assembly are not attained until some time after a maximum braking operation is completed. In extreme cases, heat buildup can cause the wheel and tire to fail with explosive force or be destroyed by fire if proper cooling is not effected. Taxiing at low speeds to obtain air cooling of overheated brakes will not reduce temperatures adequately and can actually cause additional heat buildup.

LANDING GEAR SAFETY CIRCUIT

When the weight of the airplane compresses the landing gear shock struts, a microswitch on the left main landing gear shock strut actuates the landing gear safety circuit. The safety circuit provides the following regulations to certain systems:

1. Opens the solenoid-operated cabin pressure dump valve to prevent cabin pressurization on the ground and relieve cabin pressure upon landing.
2. Energizes the solenoid-operated latch stops while on the ground so that throttles may be placed in the reverse thrust range; deenergizes the latch stops when airborne to prevent inadvertent propeller reversal.
3. Energizes the landing gear lever lock solenoid in the pedestal to prevent movement of the landing gear lever from the DOWN position while the airplane is on the ground.
4. Disarms the alternator-generator cooling scoops de-icing system to prevent overheating on the ground.
5. Opens the refrigeration bypass valve to prevent overheating of the secondary compressor.

The landing gear safety circuit receives power from the dc main bus and is protected by the "LG Lock Solenoid" circuit breaker.

Section VIII CREW DUTIES

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INTRODUCTION

In this Section, primary and alternate duties are discussed for the pilot, copilot, and flight mechanic, who make up the basic flight crew. Duties relating to the pilot, copilot, and flight mechanic do not include information already covered in Section II.

PILOT

You have military command over, and responsibility for, the crew, passengers, and the safe conduct of the flight. You will ensure that a thorough inspection of the airplane and all equipment is properly conducted in sufficient time prior to departure to permit correction of discrepancies without incurring delays. You must see to it that the other men on board understand their specific duties and know when they are to be performed. Also arrange to have all persons briefed on normal and emergency procedures and on correct use of equipment in accordance with passenger briefing this Section. Before each flight, appoint one man to be in charge of the cabin. Before an over-water flight, assign ditching duties as shown in Section III.

COPILOT

The copilot will aid the pilot as directed in order to accomplish the assigned mission.

FLIGHT MECHANIC

When the airplane is away from its home base, you are responsible for the maintenance, servicing, inspection and security of the airplane on the ground, and for determining that all miscellaneous and emergency equipment is aboard the airplane and properly installed or stowed before flight. In flight, you may be called upon to perform such other duties as the pilot may direct.

FLIGHT NURSE

1. Assume responsibility for the medical care of all patients aboard and all equipment peculiar to patient handling.
2. Advise the pilot of patient status and any necessary flight restrictions imposed by patient condition.
3. Direct activities of medical technician during flight.

MEDICAL TECHNICIAN

1. Aid the flight nurse as directed in order to accomplish the assigned mission.

PASSENGER BRIEFING CHECKLIST

PREDEPARTURE BRIEFING

1. Briefing crew member's name.
2. Airplane commander's name.
3. Destination.
4. Flight altitude.
5. Estimated time enroute.
6. Demonstrate the use of oxygen equipment.
7. Demonstrate the use of parachutes (if applicable).
8. Demonstrate the use of seat belts.
9. Indicate location of emergency equipment.
10. Describe procedures to be used during an inflight emergency.
11. Describe warning signals.
12. Caution passengers against the use of electronic equipment (portable radios, recorders, etc.)
13. Advise passengers of information cards.

OVERWATER BRIEFING

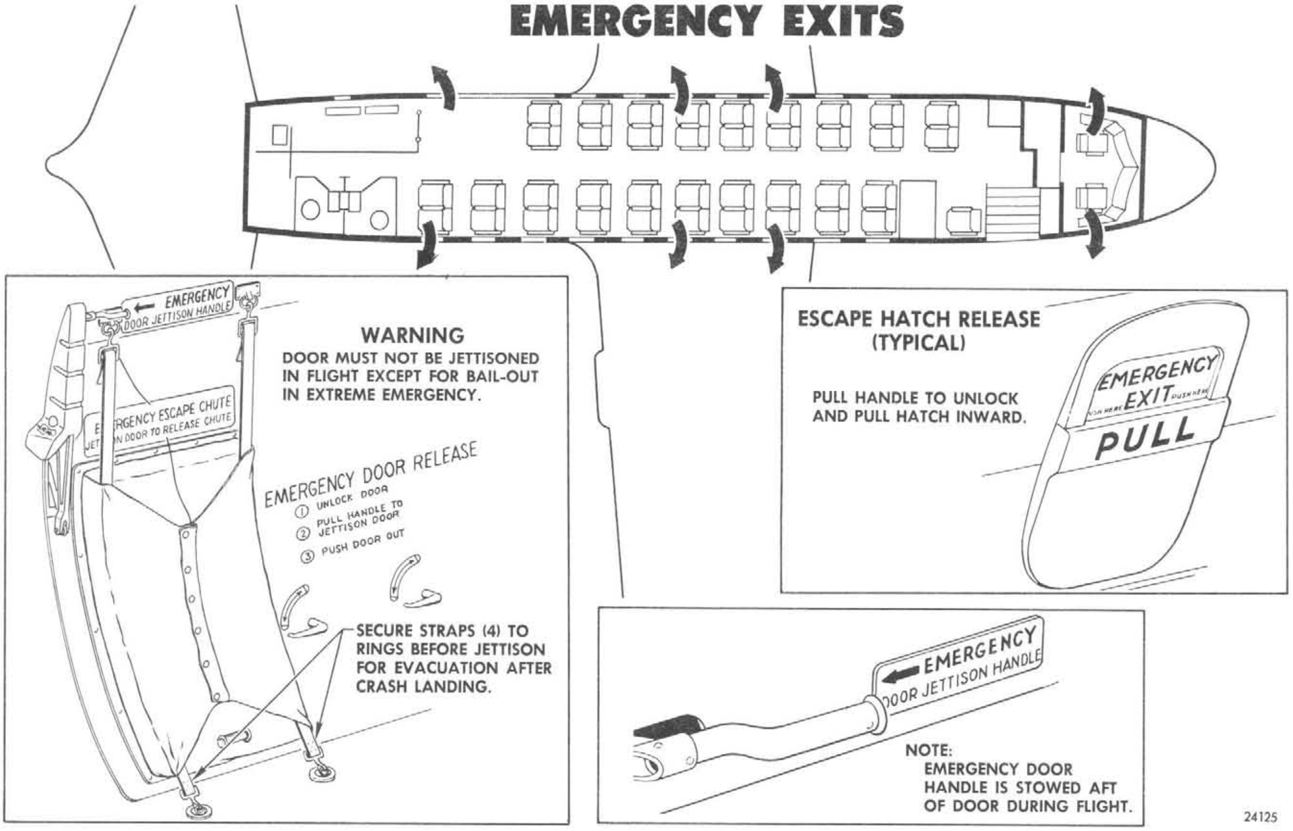
1. Describe applicable emergency equipment.
2. Describe ditching procedures.

ARRIVAL BRIEFING

1. Announce arrival time.
2. Caution passengers to observe seat belt and no smoking signs.
3. Provide any additional information as applicable.

The remaining pages in this section contain passenger information and may be removed for local reproduction without destroying the continuity of this manual.

EMERGENCY EXITS


WARNING
DOOR MUST NOT BE JETTISONED IN FLIGHT EXCEPT FOR BAIL-OUT IN EXTREME EMERGENCY.
EMERGENCY DOOR JETTISON HANDLE
EMERGENCY ESCAPE CHUTE JETTISON DOOR TO RELEASE CHUTE
EMERGENCY DOOR RELEASE
① UNLOCK DOOR
② PULL HANDLE TO JETTISON DOOR
③ PUSH DOOR OUT
SECURE STRAPS (4) TO RINGS BEFORE JETTISON FOR EVACUATION AFTER CRASH LANDING.
ESCAPE HATCH RELEASE (TYPICAL)
PULL HANDLE TO UNLOCK AND PULL HATCH INWARD.
EMERGENCY EXIT
PULL
EMERGENCY DOOR JETTISON HANDLE
NOTE: EMERGENCY DOOR HANDLE IS STOWED AFT OF DOOR DURING FLIGHT.
24125

PASSENGER INFORMATION

1. Please observe seat belt and no smoking signs.

   Seat belts will be fastened during takeoff and landing and at anytime during flight as instructed by the pilot. Smoking is prohibited during all ground operations, during and immediately after takeoff and before landings, and at any time during flight as instructed by the pilot.

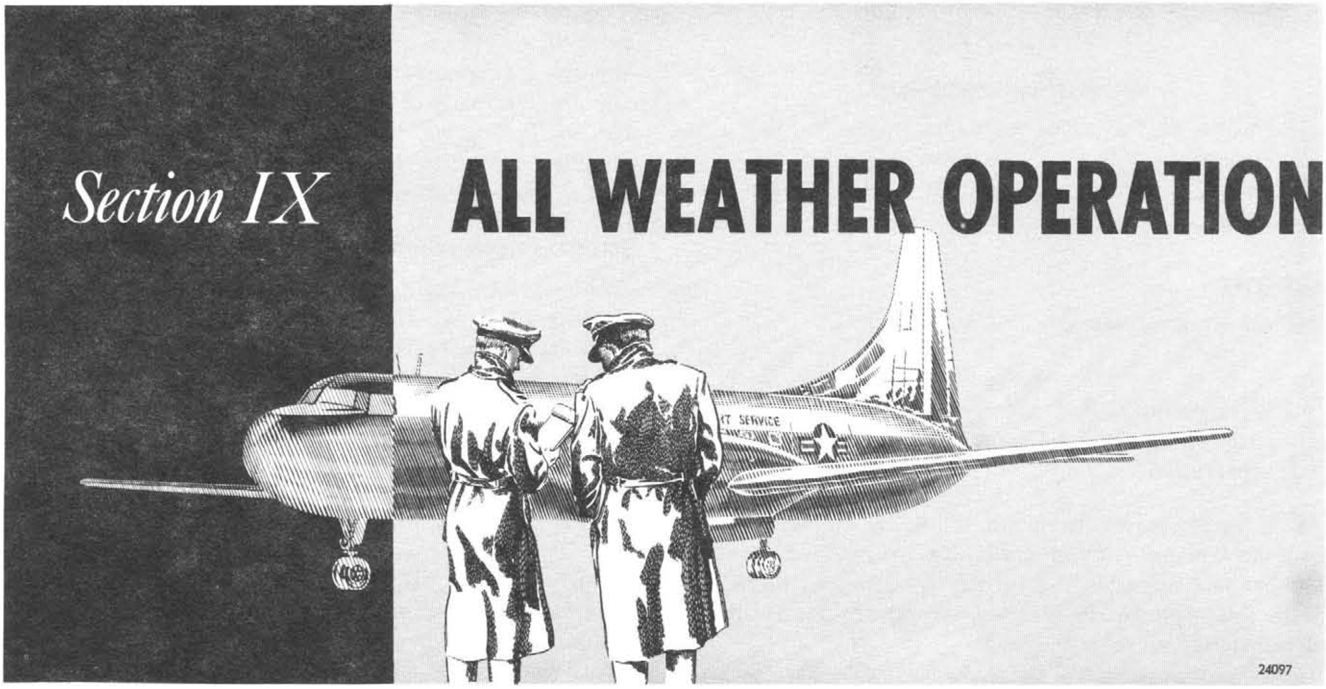
2. In the event of an inflight emergency, remain seated with the seat belt fastened and follow the pilot's or crew members instructions.

3. Emergency exits and escape routes are shown on the reverse side of this card.

CRASH LANDING OR DITCHING

1. If a crash landing or ditching situation has developed, the pilot will alert the crew and passengers with an announcement over P.A. system.
2. Fasten seat belt securely.
3. Remove cords, ties, straps; loosen collar, and parachute harness, don life vest (if applicable) but do not inflate.
4. A crew member will advise passengers which escape routes to use and aid in adjusting life vests.
5. If blankets or pillows are available, use to protect face.
6. Just prior to impact, if conditions permit, the pilot will alert the crew and passengers with an announcement over the P.A. system.
7. Brace for impact.
8. Hold crash landing positions until after the airplane has stopped moving.
9. Remove seat belt and follow the crew's instructions for evacuation.

Section IX ALL WEATHER OPERATION



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INTRODUCTION

This Section discusses special all-weather procedures and techniques which either emphasize or add to procedures and techniques presented in Sections II and III. Flying the airplane in all weather conditions requires normal instrument flight proficiency on the part of the pilot as well as the usual conscientious preflight planning. A standard procedure should be employed by the pilot and copilot during instrument takeoff and instrument approach. Power adjustments should be made by the copilot, at the direction of the pilot, which will permit the pilot to concentrate on instrument flying. The airplane is fully equipped for instrument flight. Performance data, as well as techniques and procedures, included in this all-weather section are based on standard production model airplanes.

INSTRUMENT FLIGHT PROCEDURES

PREPARATION FOR FLIGHT

Perform the preflight inspections outlined in Section II. Be sure to check operation of anti-icing and de-icing equipment during the engine runup check.

WARNING

In cold weather, make sure all instruments have warmed up sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

TAKEOFF

Recheck all instruments.

Note

During takeoff roll, the copilot should be prepared to give verbal corrections from visual observation.

At 10 knots below takeoff speed, initiate a pitch change of approximately 10° on the MM-1 attitude indicator or 1½ bar widths indication on the J-8 attitude indicator. With this attitude, the airplane should become airborne at the computed takeoff speed.

AFTER TAKEOFF — CLIMB

Raise landing gear when vertical velocity indicator and altimeter definitely indicate a climb. Establish normal climb.

HOLDING FLIGHT

For short periods of holding, reduce manifold pressure to maintain 140 KIAS. For extended holding, or if fuel consumption is a critical consideration, refer to the Appendix. Descend in holding pattern by reducing power five inches Hg and maintaining 140 KIAS. Under normal conditions, rate of descent will approximate 500 fpm.

DESCENT

Normal descent or radar controlled descent to traffic altitude can be made with cruising configuration and at cruising speed. Maintain cruising airspeed and reduce manifold pressure slightly more than one inch for each 100 fpm rate of descent desired. In addition, reduce manifold pressure approximately one inch with each 1000-foot loss of altitude to maintain the same rate of descent.

Note

Prior to letting down through an overcast, use increased carburetor heat to prevent carburetor icing. In precipitation, start windshield wiper operation before reaching final approach.

INSTRUMENT APPROACHES

This airplane is equipped for performing most types of instrument approaches and no special techniques are required. Letdowns in the clean configuration or with wing flaps and landing gear extended are at the discretion of the pilot; however, items of airplane configuration are to be initiated no later than outlined in figures 9-1 through 9-3. When low ceiling conditions exist, it may be desirable to hold configuration (approach flaps) and land instead of trying to lower landing flaps at the last minute. If it is necessary in an emergency to make a landing by reference to the instruments only, the rate of descent during the last 100 feet should be adjusted to less than 500 fpm. This will bring the nose up slightly and a landing will be made on the main wheels.

INSTRUMENT LANDING SYSTEM APPROACHES

This airplane is equipped with an approach coupler which permits automatic ILS approaches. The only difference in the procedure employed between manual and automatic approaches is that the autopilot is used in the automatic approach. When near contact, the autopilot is turned off and a manual landing is accomplished. (See figure 9-3.)

SINGLE-ENGINE OPERATION

For approved procedures for single-engine operation refer to Section III. The critical relationship between wing flaps and airspeed during instrument takeoff must be thoroughly understood. If the airplane is allowed to fly off the ground, sufficient airspeed is generally attained prior to gear retraction to allow flap retraction without developing a dangerous situation. In the event of engine failure on takeoff, after sufficient airspeed has been attained, a normal climb-out and instrument approach is practicable. During single-engine operation, it is imperative that airspeed be held at or above the values shown in figure 3-1. The windshield and propeller de-icing systems are powered by alternator ac bus. No. 1. If the right engine only is operating, the No. 2 alternator power must be transferred to bus No. 1.

CIRCLING APPROACH

The circling approach will be made under contact flight conditions after completion of the instrument approach. While maneuvering into the landing position, the landing runway shall be kept in sight at all times. Maintain airspeed for approach flap setting (1.4 stall speed minimum). When on base leg, normal procedure will be used to complete the landing.

ICE AND RAIN

ICING

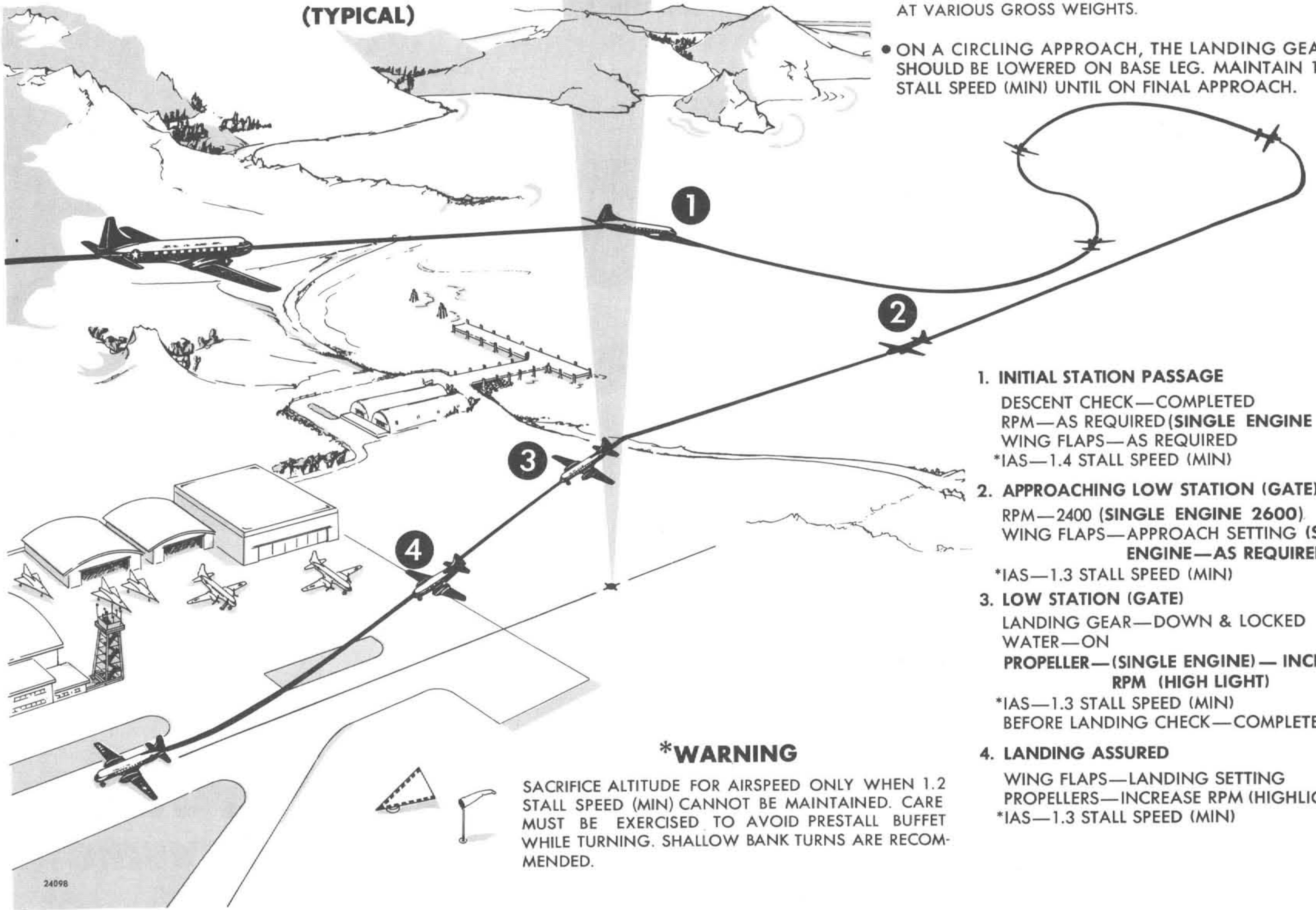
The airplane is equipped with the necessary wing and tail anti-icing, pitot heat, carburetor heat, propeller de-icing and windshield anti-icing systems to enable it to fly with safety in moderate icing conditions as defined by Air Weather Service or light icing as defined by the U. S. Weather Bureau.

WARNING

Avoid flight through known or forecast severe or extreme (Air Weather Service) and moderate or heavy (U. S. Weather Bureau) icing conditions.

NORMAL AND SINGLE ENGINE RADIO RANGE, ADF, VOR AND TACAN APPROACH

(TYPICAL)



NOTE

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED. THESE ITEMS MAY BE PERFORMED BEFORE, BUT IN NO CASE LATER THAN THE POINT INDICATED ON THE DIAGRAM.
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.
- ON A CIRCLING APPROACH, THE LANDING GEAR SHOULD BE LOWERED ON BASE LEG. MAINTAIN 1.4 STALL SPEED (MIN) UNTIL ON FINAL APPROACH.

1. **INITIAL STATION PASSAGE**
   DESCENT CHECK—COMPLETED
   RPM—AS REQUIRED **(SINGLE ENGINE 2600)**
   WING FLAPS—AS REQUIRED
   *IAS—1.4 STALL SPEED (MIN)
2. **APPROACHING LOW STATION (GATE)**
   RPM—2400 **(SINGLE ENGINE 2600)**
   WING FLAPS—APPROACH SETTING **(SINGLE ENGINE—AS REQUIRED)**
   *IAS—1.3 STALL SPEED (MIN)
3. **LOW STATION (GATE)**
   LANDING GEAR—DOWN & LOCKED
   WATER—ON
   PROPELLER—(SINGLE ENGINE)— INCREASE RPM (HIGH LIGHT)
   *IAS—1.3 STALL SPEED (MIN)
   BEFORE LANDING CHECK—COMPLETED
4. **LANDING ASSURED**
   WING FLAPS—LANDING SETTING
   PROPELLERS—INCREASE RPM (HIGHLIGHTS)
   *IAS—1.3 STALL SPEED (MIN)

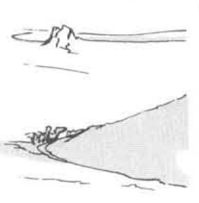
***WARNING**

SACRIFICE ALTITUDE FOR AIRSPEED ONLY WHEN 1.2 STALL SPEED (MIN) CANNOT BE MAINTAINED. CARE MUST BE EXERCISED TO AVOID PRESTALL BUFFET WHILE TURNING. SHALLOW BANK TURNS ARE RECOMMENDED.

Figure 9-1

NORMAL AND SINGLE ENGINE RADAR APPROACH

(TYPICAL)



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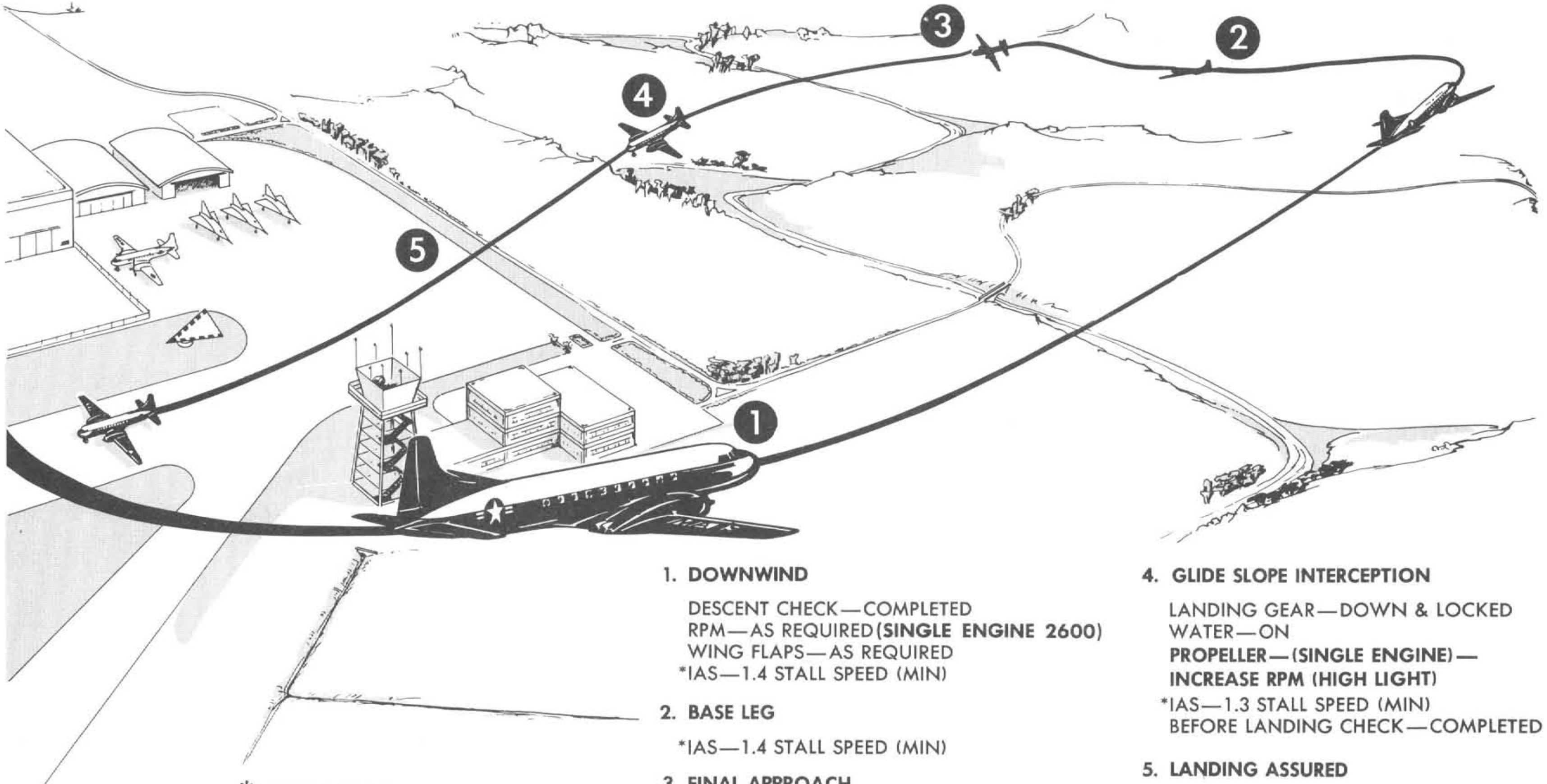
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.



***WARNING**

SACRIFICE ALTITUDE FOR AIRSPEED ONLY WHEN 1.2 STALL SPEED (MIN) CANNOT BE MAINTAINED. CARE MUST BE EXERCISED TO AVOID PRESTALL BUFFET WHILE TURNING. SHALLOW BANK TURNS ARE RECOMMENDED.

1. **DOWNWIND**

   DESCENT CHECK—COMPLETED
   RPM—AS REQUIRED **(SINGLE ENGINE 2600)**
   WING FLAPS—AS REQUIRED
   *IAS—1.4 STALL SPEED (MIN)

2. **BASE LEG**

   *IAS—1.4 STALL SPEED (MIN)

3. **FINAL APPROACH**

   RPM—2400 **(SINGLE ENGINE 2600)**
   WING FLAPS—APPROACH SETTING **(SINGLE ENGINE—AS REQUIRED)**
   *IAS—1.3 STALL SPEED (MIN)

4. **GLIDE SLOPE INTERCEPTION**

   LANDING GEAR—DOWN & LOCKED
   WATER—ON
   PROPELLER—(SINGLE ENGINE)—INCREASE RPM (HIGH LIGHT)
   *IAS—1.3 STALL SPEED (MIN)
   BEFORE LANDING CHECK—COMPLETED

5. **LANDING ASSURED**

   WING FLAPS—LANDING SETTING
   PROPELLERS—INCREASE RPM (HIGHLIGHTS)
   *IAS—1.3 STALL SPEED (MIN)

Figure 9-2

NORMAL AND SINGLE ENGINE ILS APPROACH

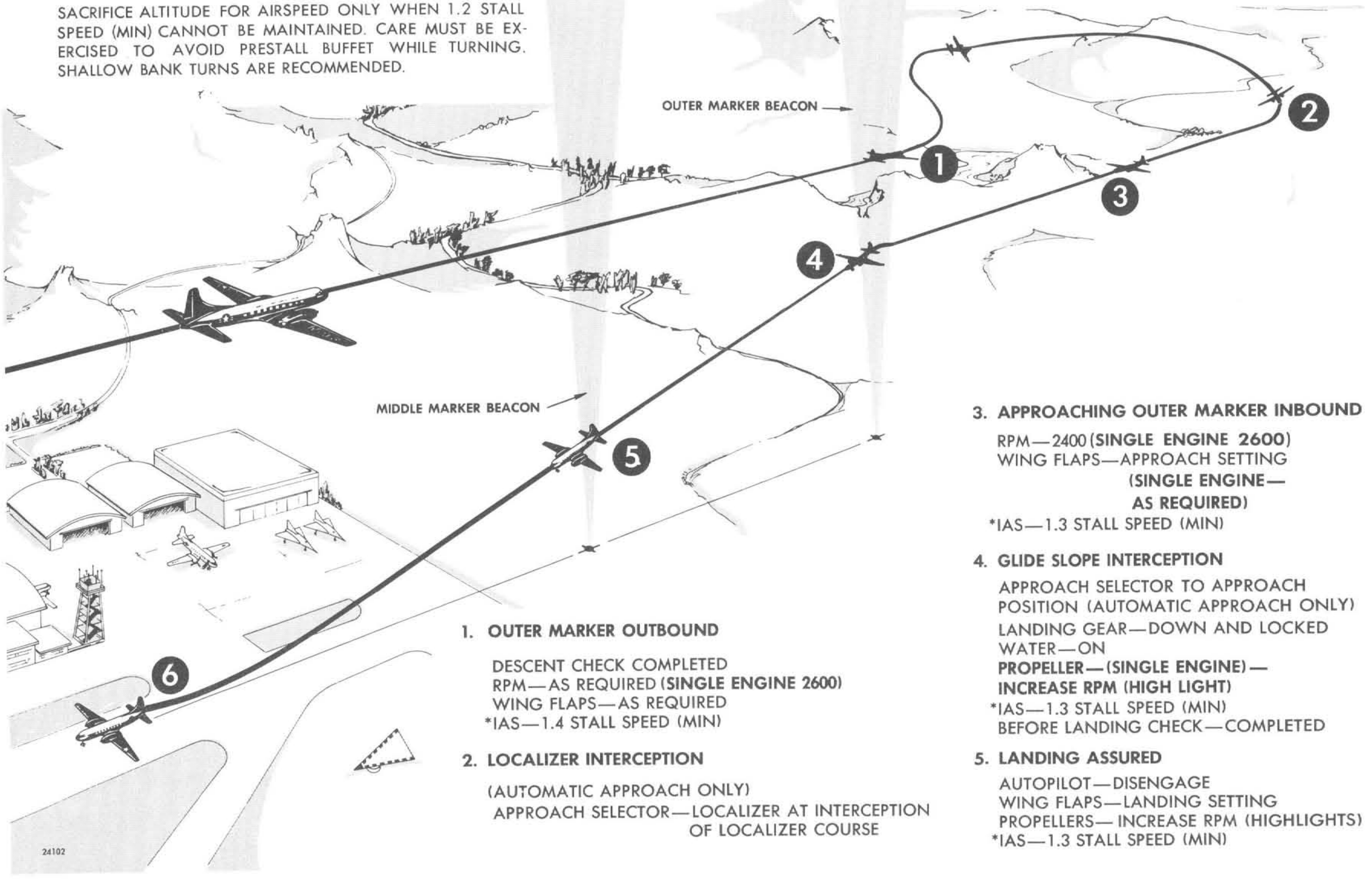
(TYPICAL)

*WARNING

SACRIFICE ALTITUDE FOR AIRSPEED ONLY WHEN 1.2 STALL SPEED (MIN) CANNOT BE MAINTAINED. CARE MUST BE EXERCISED TO AVOID PRESTALL BUFFET WHILE TURNING. SHALLOW BANK TURNS ARE RECOMMENDED.

NOTE

- THIS IS A TYPICAL DIAGRAM WHICH IS NOT MEANT TO SHOW THE INTENDED FLIGHT PATH BUT DOES INDICATE A CHRONOLOGICAL ORDER FOR THE ITEMS TO BE PERFORMED. THESE ITEMS MAY BE PERFORMED BEFORE, BUT IN NO CASE LATER THAN THE POINT INDICATED ON THE DIAGRAM.
- REFER TO APPENDIX FOR FLAP SETTINGS AND AIRSPEEDS AT VARIOUS GROSS WEIGHTS.



1. **OUTER MARKER OUTBOUND**

DESCENT CHECK COMPLETED
RPM—AS REQUIRED (**SINGLE ENGINE 2600**)
WING FLAPS—AS REQUIRED
*IAS—1.4 STALL SPEED (MIN)

2. **LOCALIZER INTERCEPTION**

(AUTOMATIC APPROACH ONLY)
APPROACH SELECTOR—LOCALIZER AT INTERCEPTION OF LOCALIZER COURSE

3. **APPROACHING OUTER MARKER INBOUND**

RPM—2400 (**SINGLE ENGINE 2600**)
WING FLAPS—APPROACH SETTING (**SINGLE ENGINE—AS REQUIRED**)
*IAS—1.3 STALL SPEED (MIN)

4. **GLIDE SLOPE INTERCEPTION**

APPROACH SELECTOR TO APPROACH POSITION (AUTOMATIC APPROACH ONLY)
LANDING GEAR—DOWN AND LOCKED
WATER—ON
PROPELLER—(SINGLE ENGINE)—INCREASE RPM (HIGH LIGHT)
*IAS—1.3 STALL SPEED (MIN)
BEFORE LANDING CHECK—COMPLETED

5. **LANDING ASSURED**

AUTOPILOT—DISENGAGE
WING FLAPS—LANDING SETTING
PROPELLERS— INCREASE RPM (HIGHLIGHTS)
*IAS—1.3 STALL SPEED (MIN)

Figure 9-3

Figure 9-4 Deleted

Moderate icing as defined by AWSR 55-13 is: rate of accretion such as to create a hazard if flight prolonged in icing zone, but insufficient to make immediate diversionary action necessary. Occasional use of de-icing equipment may be necessary. Light icing as defined by the U. S. Weather Bureau is: an accumulation of ice which can be disposed of by operating de-icing equipment, and which presents no serious hazard. Light icing will not cause alteration in speed, altitude, or track. Operation of the anti-ice and de-icing systems is described in Sections IV and VII. Additional information and specific procedures are given under COLD WEATHER PROCEDURES, this Section.

WARNING

Failure to remove snow and ice accumulations on the airplane while on the ground can result in serious aerodynamic and structural effects when flight is attempted. Takeoff distances and climb-out performance can be adversely affected, depending upon the weight and distribution of the accumulated snow and ice. The roughness pattern, and location of the snow and ice could affect stall speeds and handling characteristics to a dangerous degree. In flight, structural damage has also resulted due to vibration induced by unbalanced loads of unremoved accumulations. To eliminate these hazards, ice and snow must be removed from the airplane before flight is attempted.

WING AND TAIL ANTI-ICING

The wing and tail anti-icing system should be used as an anti-icer rather than as a de-icer. It is more satisfactory in the physical results and is simpler in operation. *For most efficient operation, always turn on and heat-soak the anti-icing system at least 30 minutes before entering an icing area.* The purpose of the system is to produce enough heat in the wing and tail leading edges to evaporate most of the moisture or precipitation. Moisture which does not evaporate runs back over the surface of the wing and freezes over the cold area. This is called "runback." Presence of runback does not mean that the wing and tail anti-icing system is functioning improperly. The pilot should observe the total accumulation of ice on the airplane, including runback, and take corrective action to avoid continued icing. Avoid holding in moderate to heavy icing conditions.

Note

Icing conditions which cause runback to reach the wing flaps and ailerons is considered heavy icing and should be avoided. When holding in icing conditions, use sufficient power to provide adequate leading edge temperatures. Adjust augmentor vanes as required.

WARNING

Stall warning in the form of buffet will occur at higher airspeeds than normally when the airplane is weighted with accumulations of ice. The buffet warning zone is also narrower and stall will be encountered at higher airspeed than in normal conditions. Govern approach and landing speed accordingly.

SINGLE-ENGINE ANTI-ICING OPERATION

In single-engine operation during icing conditions, the operating engine must assume the entire load of maintaining adequate wing and tail anti-icing heat. To provide adequate heat for the entire system, the operating engine's cylinder head temperatures must be increased to near maximum limits. The following procedure is recommended:

1. Manual heat anti-icing shutoff handle for shutdown engine – OFF.
2. Operative engine power – METO.
3. Augmentor vane switch – CLOSE (to approximately 60°).

Note

If augmentor overheat warning bell rings and vanes trail, reset vanes to lesser closure.

4. Cylinder head temperature – Maintain 250°C to 260°C.
5. Nacelle flaps – As required but not to exceed mid position.

WARNING

Cylinder head temperatures must be monitored very closely. Every effort must be made to reach an ice-free flight level as soon as possible so that cylinder head temperatures may be reduced to normal values.

PITOT HEAT, PROPELLER DE-ICING AND WINDSHIELD ANTI-ICING

As with wing and tail anti-icing, prevention of ice formation on propellers, windshields, and pitot tubes is far more efficient and satisfactory than attempting to get rid of ice once it has formed. The NESA glass windshield panels are efficient when the lowest power settings are used; however, if it becomes necessary to use high power, the windshield panels must be warmed up on low power before full heat may be applied safely.

DIRECT-VISION WINDSHIELD

Opening of the direct-vision windshields permits a visual landing in event the windshields are covered with ice. For best results it is necessary to lean as far to the side as possible. This directs considerable wind into the pilot's face. Under these circumstances it is difficult for the pilot to monitor his own airspeed indicator and it is advisable to use the copilot's airspeed indicator to govern final approach speed.

Note

> It is possible for the direct-vision windows to interfere with the control column if the window stop is defective.

TURBULENCE AND THUNDERSTORMS

CAUTION

> Avoid penetrating a thunderstorm if it is possible to fly around it. Some routine flight operations require a certain amount of thunderstorm flying since it is not always possible to avoid storm areas. At night it is often impossible to detect individual storms and to find the in-between clear areas. However, pilots using modern equipment and possessing a combination of proper experience, common sense, and instrument flying proficiency can safely fly through thunderstorm areas.

BEFORE TAKEOFF

Make a thorough analysis of the general weather situation in order to plot thunderstorm areas. Prepare a flight plan which will require the least possible exposure of the airplane to regions of possible thunderstorms. Be sure to check proper operation of all flight instruments, navigation equipment, pitot heaters, and instrument panel lights before attempting flight into thunderstorm areas.

DURING FLIGHT

If a thunderstorm penetration is necessary, establish the airplane attitude and power settings to obtain an airspeed of 60 KNOTS ABOVE THE STALL SPEED for the weight and configuration being flown, prior to entry into the storm. Maintain this attitude and power setting throughout the storm and the airspeed will remain approximately constant in spite of erroneous indications. The use of the autopilot with the altitude control OFF is recommended. Prepare the airplane when entering an area of turbulence and possible thunderstorms as follows:

1. Adjust power to obtain an airspeed of 60 KNOTS ABOVE STALL SPEED.
2. Pitot heat switch – ON.
3. Wing and tail anti-icing, propeller de-icing and carburetor heat – ON, if required.
4. Check gyro instruments for proper settings.
5. All safety belts fastened securely (check crew).
6. Turn off radio equipment affected by static.
7. At night, turn all white floodlights to high intensity.
8. If desired, engage autopilot with altitude control OFF. Monitor closely.

NIGHT FLYING

Night flying presents no unusual problems. Before takeoff, make certain that all lights function properly. With flight compartment white lights off and red lights on, instruments will be easily visible, maximum visibility will be afforded in the cabin, and changeover to flying on instruments can be readily accomplished. The procedure for night landing is the same as for normal daylight landing except for the use of landing lights. These must be extended and turned on by placing the landing light switches to the EXTEND and ON positions during final approach. Observe landing light extension airspeed limitations.

COLD WEATHER PROCEDURES

Many of the difficulties encountered during operation in extreme cold weather result from lack of understanding of the proper steps to be taken prior to and immediately after flight. It is important, therefore, that the flight crew be fully aware not only of the necessary procedures and precautions to be observed during flight, but also of the preflight and postflight operational procedures relative to cold weather operation. Proper engine shutdown, using oil dilution, is especially important. It should never be necessary to drain oil when the proper dilution procedure has been accomplished. The use of oil dilution after flight and of ground heating equipment before flight should allow engine starts to be made regardless of the outside temperatures. If external heat will not be available for starting, or dilution cannot be accomplished, the oil should be drained into clean containers and stored in a sheltered location where the temperature will not be below freezing.

EXTERIOR INSPECTION

1. Check for removal of ice, snow, and frost from wing and tail surfaces. Check that the leading edges of the control surfaces are clean. If hot air has been used, make certain that the areas are dry and ice-free.
2. Check that the leading edge seals of the elevators and rudder are flexible. No attempt should be made to move the surface controls until the seals are sufficiently pliable to preclude the possibility of cracking them.

CAUTION

- Hot water should not be used to remove frost or ice unless the airplane is sheltered in a warm hangar, as additional ice may form and aggravate the difficulty.
- Before moving the airplane from a hangar to freezing temperatures outside, sponge off critical areas where water may have accumulated.

3. Do not direct removal of engine protective shields, nacelle covers, or propeller blade covers until just before starting engines. Make every effort to keep ground heater air in contact with the engine and accessories until ready for the propeller pull-through procedure.
4. Check engine preheating. Preheat is required if temperatures are below −18°C (0°F) even though oil dilution was accomplished at shutdown. Preheat may be required at temperatures below 2°C (35°F). Preheat should not be considered adequate until fluid oil will flow from the main oil tank sump drains, and the propellers can be turned with the starter.

CAUTION

In extreme cold, congealed oil behind the piston rings prevents them from compressing to conform with any taper that may exist in the cylinder bore. Pistons "frozen" in this manner may be damaged when the engine is started. If the propellers cannot be rotated easily by use of the starter, the engine has not been sufficiently preheated.

5. Check landing gear struts, actuating cylinders, locking mechanism, wheels and brakes for freedom from ice, snow, slush, mud, frost, etc. Check landing gear limit switches for freedom from ice.
6. Determine that all exposed or vital operating surfaces on the landing gear (strut, pistons, etc.) are coated with a film of hydraulic fluid.
7. See that tires are not frozen to the ground or to the wheel chocks. Direct that ground heaters first be used to thaw frozen tires. In cases of extreme emergency, tires may be freed by overinflating to 1.5 times the normal tire pressure.

CAUTION

- To avoid excessive strain on tires, do not apply heat to overinflated tires.
- Make certain that tire pressure is reduced to normal limits after using overinflation method.
- Do not attempt to move the airplane until tires are free.

8. Check pitot drain lines for freedom from ice. The drain plugs are located in the top forward section of the nose wheel well.
9. Determine battery fluid level and specific gravity.

Note

If the fluid level is low, remove the batteries and install fully serviced and fully charged batteries. If fluid is added to a battery just before starting engines, the battery will not produce maximum power.

10. Check oil tank sump drains for freedom of flow. Drain enough oil to make certain that oil is flowing from tank and not merely from the drain line. If oil does not flow, or if flow is sluggish, direct that additional heat be applied locally to the tank sump and oil lines.

Note

If necessary, drain and heat the oil to approximately 75°C (167°F); return it to the tank immediately before engine is started.

11. Check fuel drains for freedom from ice, mud, etc.
12. See that all fuel, water, and oil tank vent lines and engine crankcase breathers are free of frozen condensate.
13. Check engine stiffness periodically to determine when sufficient ground heater air has been applied. If the propeller cannot be turned with the starter, the engine is not warm enough to start. In this case, continue to preheat the engine.

Note

With a ground heater delivering from 75,000 to 90,000 BTU per hour, at least 45 minutes will be required at a temperature of −34.4°C (−30°F) to −40.0°C (−40°F) to preheat the engine.

14. If it is determined that sufficient heat has been applied and the propeller still cannot be moved, a hydraulic lock probably exists. Remove spark plugs from bottom cylinders, let cylinders drain, pull propeller through by hand, reinstall plugs, and attempt to start again.
15. Direct that the flight compartment enclosure cover be removed.
16. Check that dc external power is connected. External 115-volt ac power should be connected, if available.

BEFORE STARTING ENGINES

1. Determine that heat has been applied generally to the cabin and the flight compartment and locally to the radio equipment rack, electrical equipment rack, radar equipment rack and to flight and engine instrument panels.
2. Check rear loading door, escape hatches, and flight compartment windows to make certain they will open. Then close and secure.

Note

It is customary in extreme cold weather to leave a small opening in the cabin and/or the flight compartment after the last engine shutdown to permit circulation of air inside the airplane as a frost preventive measure.

WARNING

In cold weather, make sure all instruments have warmed sufficiently to insure normal operation. Check for sluggish instruments during taxiing.

3. Check pitot heater operation by observing ammeters.
4. Place reserve oil heat switch to HEAT position. Check heater indicator lights. The initial heater light and the maintenance heater light should illuminate.
5. See that the parking brake handle is in the OFF position. If the parking brakes have been left on, the brakes may be frozen. If necessary, direct that heat be applied to the brake discs and cylinders.
6. Direct that engine protective shields, nacelle covers, and propeller blade covers be removed. This should be the last operation before starting the engines.

STARTING ENGINES

Except as noted in the following paragraphs, make cold weather starts using the procedures described in Section II for normal starts.

Note

If a battery start must be made, reduce electrical load to a minimum and turn off the inverter. After engine has been started, turn inverter switch to MAIN.

Proceed as follows:

1. Under extreme cold conditions, it may be necessary to place the mixture control lever momentarily in AUTO RICH during engine cranking to obtain a sufficient amount of vaporized fuel to support combustion.
2. Do not crank continuously for a period longer than one minute (30 seconds on battery). If the engine does not start, allow the starter to cool for at least one minute. After the second and succeeding cranking cycles, allow five minutes for cooling.
3. Prime only after propeller starts to rotate. If primed prematurely, the gasoline will not vaporize. In extreme cold, operate the prime switch intermittently until regularity of firing results. It may then be necessary to continue priming for a short time after starting to maintain smooth engine operation.

CAUTION

Do not overprime. Scuffed cylinders, engine failures, and fires may result from overpriming.

4. Try to catch the engine on the first starting attempt. Ice may form on the spark plug points within a few seconds if the engine fires and quits. If the engine has not started after two or three attempts, it will save time to remove several spark plugs and examine them for ice. If icing has occurred, the front plugs should be removed and heated to dry the points before making another starting attempt.
5. If there is no oil pressure after approximately 30 seconds of engine operation, shut down engine and investigate.

Note

Do not be alarmed if the oil pressure is abnormally high immediately after starting. This is allowable; but as the oil temperature increases, the oil pressure should drop rapidly to normal. Do not increase engine speed until oil temperature and pressure are within limits.

6. Move carburetor heat control levers to HOT as soon as engine is firing regularly to improve operation. Return to COLD when engine operation is satisfactory.

ENGINE GROUND OPERATION

1. In extremely cold weather, oil congealing in the oil cooler may produce misleading indications. When this happens, the first indications are extremely high oil temperature and a reduction in oil pressure. Then, as the congealed oil is forced into the system, there is a sudden drop in temperature accompanied by an extreme rise in pressure. It is advisable to check oil temperature and pressure carefully in cold weather, allowing sufficient time for a thorough engine warmup. Oil pressure may go as high as 400 psi immediately after starting. This is allowable. As the oil temperature increases, the pressure will rapidly drop to normal.

2. In cold weather, engine operation immediately after starting is frequently rough, with backfiring and after-firing due to poor vaporization of fuel, low cylinder head temperatures, and frosted spark plug points. Use of carburetor heat as soon as the engine is firing regularly will improve fuel vaporization and combustion.
3. When warming up an engine in which the oil has been properly diluted, 10 minutes at 50°C or above will evaporate sufficient gasoline from the oil to preclude difficulty with oil scavenging. To return diluted oil to its original viscosity, an engine should be run for approximately 45 to 60 minutes at its normal operating temperatures. High oil temperatures, above 70°C, will shorten this time slightly.
4. After several days layover, during which an engine has been started and the oil diluted several times, it is advisable to make a ground run for at least 30 minutes, at normal temperatures, before takeoff. Also check the oil level; it will fall due to evaporation of gasoline. This ground run will correct excess dilution which might otherwise cause oil discharge through the breathers or oil pressure drop during high-power takeoff.
5. When making a manifold pressure-rpm relationship check in cold weather, it may be noticed that the rpm will not quite come up to 2000. This is normal and is due to the increased air density at extreme low temperatures and the consequent increased air load on the propellers.
6. Throttles should be kept at a preliminary setting of 800-1000 rpm, depending upon the effectiveness of oil dilution at the previous engine shutdown. If oil pressure is steady and within limits, the preliminary warmup period may be shortened and the throttles advanced gradually to normal warmup rpm. Use carburetor alternate air levers in HOT position as necessary to assist vaporization and prevent backfiring. This will be especially important at temperatures of 0°F and below. After engine is well warmed, engine operation will be satisfactory with carburetor alternate air lever in COLD.
7. If oil pressure registers and then drops below normal after a few minutes of operation, shut down engine and check for failed pressure gage, blown oil lines or oil cooler, congealed oil, and engine front and rear oil strainer drain plugs for foreign matter, ice, etc.
8. At temperatures below −18°C (0°F), use nacelle flaps as required to maintain cylinder head temperatures of 200°C or less.
9. If oil temperature fluctuates or drops off with increase in rpm, reduce rpm and continue warmup at a lower rpm until oil temperature responds to increased engine speeds.
10. Exercise propellers from high rpm limit to low rpm limit and back to high rpm limit several times to circulate warm oil through the propeller governing system.

WING FLAP CHECK

Direct ground crew to observe wing flaps carefully and, with the hydraulic pressure bypass handle in PRESS (DWN) position, operate the wing flap switch to move the flaps through one complete cycle (fully up, then to 39° down, and return to fully up). As flaps operate, check with ground crew and observe the wing flap position indicator to make certain that the flaps reach their extreme positions without hindrance from undetected snow or ice. Stop flaps at various positions to determine if the control and position indicator are in working condition.

PROPELLER MANUAL FEATHERING CHECK

Make a propeller manual feathering check in cold weather. If the rpm drop is very slow or sluggish, repeat the check until satisfactory operation is obtained. Otherwise, overspeeding may occur on takeoff. If propeller does not feather after three or four attempts, shut down engine and apply ground heater air to engine front accessory case, propeller dome, and feathering lines. Check system for malfunctioning.

TAXIING

Before starting to taxi, direct ground crew to check that the tires are not frozen to the ground. If precipitation is encountered prior to takeoff, or if icing conditions are anticipated, turn alternator switches and pitot heat switch to ON, and activate windshield anti-icing system.

Note

On the ground, airflow into the augmentor muffs is not sufficient to provide wing and tail anti-icing.

Use asymmetrical power applications for taxi steering on icy runways. Avoid using brakes. Make certain that the nose wheel is in line with the takeoff path before applying power for takeoff.

BEFORE TAKEOFF

1. If icing conditions prevail, place heat anti-icing button in PUSH ON position and hold nacelle flap switches to CLOSE. Check cabin pressure manual dump valve handle for NORMAL position. Turn cabin heat switch to AUTO. Leave augmentor vanes in trail for takeoff. Cabin heat will not rise to the desired range while wing and tail anti-icing is in operation, but placing the cabin heat and vent switch in NORMAL and the cabin heat switch in AUTO at this time will assure obtaining the greatest possible benefit from the heat developed in the ventilating air by effect of the air compressor. It

will also obviate the need of positioning the cabin heat switches after the wing and tail anti-icing system is turned off.

2. Perform propeller autofeather test (approximately 300 rpm drop) just before takeoff to insure presence of warm oil in the propeller governor and feathering lines. After test, turn autofeather switch to OFF and then to ON to rearm autofeather system. Leave switch on for takeoff.

TAKEOFF

WARNING

Failure to remove snow and ice accumulations on the airplane while on the ground can result in serious aerodynamic and structural effects when flight is attempted. Takeoff distances and climb-out performance can be adversely affected, depending upon the weight and distribution of the accumulated snow and ice. The roughness pattern and location of the snow and ice could affect stall speeds and handling characteristics to a dangerous degree. In flight, structural damage has also resulted due to vibration induced by unbalanced loads of unremoved accumulations. To eliminate these hazards, ice and snow must be removed from the airplane before flight is attempted.

CAUTION

For takeoff in colder than standard conditions (with carburetor air temperature below 15°C) avoid overboosting the engines beyond their ratings. Observe torque pressure limits, during takeoff and reduce manifold pressure approximately 0.5 inch Hg for each 5°C below standard CAT (15°C at sea level).

1. Carburetor heat may be used on takeoff in cold weather to aid the vaporization of fuel and improve carburetor performance. However, special precaution should be taken to maintain carburetor air temperature below or above the critical icing range while staying below the maximum allowable temperature for low blower. After a takeoff with carburetor heat on, the carburetor air temperature may increase rapidly during the following climb if the engines are operating at high power. If temperatures go beyond the safe range, there will be loss of manifold pressure and power. Watch the carburetor air temperature gage and be ready to reduce or shut off carburetor heat if temperatures go too high.
2. During cross-wind takeoff run on an icy runway, use asymmetrical power for directional control until rudder control becomes effective.

WARNING

The use of asymmetrical power for directional control will appreciably increase the required takeoff distance.

AFTER TAKEOFF — CLIMB

After taking off from a snow-covered or slush-covered runway and after reaching an altitude of approximately 500 feet above the terrain, operate the landing gear and wing flaps through several complete cycles to prevent their freezing in the retracted position.

Note

Maintain airspeed below maximum landing gear retraction speed while cycling the landing gear.

During climb the heat available for cabin heat can become marginal if the nacelle flaps are left open. Close the nacelle flaps as far as possible, consistent with maximum cylinder head temperature limitations. This will provide the maximum heat available for cabin heating.

CRUISE

1. When cruising under severe icing conditions, use at least 75% of maximum continuous power with mixture control levers in AUTO RICH.

Note

- Refer to Section VII for additional information on carburetor icing.
- At low power settings, low cylinder head and carburetor air temperatures will result in inefficient fuel vaporization and distribution which will in turn cause rough engine operation. Sufficient carburetor heat should be applied to obtain smooth operation. Placing mixture control lever in AUTO RICH may also correct rough engine operation, but proper use of carburetor heat is preferable to operation in AUTO RICH because decreased fuel consumption is thus obtained.

2. Increase propeller speed momentarily about 200 to 300 rpm every half hour to check operation of propeller governor.
3. During anti-icing operations close the augmentor vanes and adjust nacelle flaps to maintain cylinder head temperatures within limits.
4. Exercise carburetor heat controls periodically to prevent controls from freezing.

5. In the event of single-engine operation during icing conditions, immediately operate (pull down and turn clockwise) the manual heat anti-icing shutoff handle to OFF position for the nacelle with the inoperative engine. Turn cabin heat OFF. Close augmentor vane to 80° and operate nacelle flaps on operative engine as required to maintain CHT. If augmentor overheat warning bell rings, reset vanes to lesser closure. Apply power as necessary to operative engine. Use high blower if necessary.

DESCENT

Temperature inversions may occur when the weather is extremely cold, and the ground air may be 15 to 30°C (27 to 54°F) colder than the upper air. If this is the case, take care to avoid rapid cooling during descent, even when using somewhat high engine power. Lower the landing gear and use part flaps to reduce airspeed while descending. Keep considerable power on the engines and regulate nacelle flaps to prevent overcooling the engines. If possible, maintain cylinder head temperatures above 100°C and oil temperatures above 30°C during all letdowns. Closing the augmentor vanes will help in maintaining cylinder head temperatures. If the augmentor vanes are closed during descent, they must be opened before landing, to avoid overheating during ground operation. Place carburetor heat control levers in HOT as necessary to obtain maximum allowable carburetor air temperature.

Note

- Part throttle operation during descent in cold weather and moisture conditions often results in formation of carburetor ice. If prolonged part throttle operation is required in icing air, especially in instrument weather, maintain carburetor air temperature close to the maximum for the blower setting in effect.
- Carburetor air heat will also assist in preventing spark plug fouling.

Maintain throttle setting at approximately 2100 rpm. Placing mixture control levers in AUTO RICH is necessary for cooling only after accomplishing above items. Keep airplane in the anti-icing configuration.

BEFORE LANDING

Maintain a power setting sufficient to prevent overcooling of the engines. Use carburetor heat as necessary. If you anticipate water-covered or slush-covered runways, turn the windshield anti-ice switch to BOTH MAIN LOW and DV windshield anti-ice switch to START approximately 30 minutes before landing. Turn switches to BOTH MAIN HIGH (DV OFF) for full heat five minutes before landing. Use of reverse thrust may throw slush or water ahead of the airplane.

LANDING

CAUTION

Use caution when using brakes on an icy runway.

Use rudder for directional control until propeller reverse pitch change is accomplished. Then, when landing on an icy runway, use asymmetrical power for steering control. If the landing is made on a water-covered or slush-covered runway, turn the windshield wipers on before using reverse thrust. After the landing roll, move the heat anti-icing button to PULL OFF. Turn the propeller de-ice switch off. Make the turn-off from the runway slowly to prevent skidding. Turn windshield anti-ice switches off and windshield wiper knob off as soon as the airplane is parked.

ENGINE SHUTDOWN

Oil Dilution Procedure

1. Before stopping engines in cold weather, oil in the engine oil tanks and the circulating system must be diluted with fuel to keep the oil from congealing before the next engine start.

CAUTION

Oil dilution shall not be attempted when oil temperature is above 50°C since the heat of the oil will evaporate the fuel. Whenever a long dilution period is required, and the oil temperature exceeds 50°C during the course of the dilution, the engines should be stopped temporarily to allow the oil temperature to drop. Dilution then should be continued to complete the required dilution time.

2. To dilute the oil, operate engines at 800-900 rpm, turn fuel booster pump switch ON, hold oil dilute switch ON, and shut down the engine at the end of the dilution time indicated in figure 9-5.
3. Prior to stopping the engine, and while keeping the dilute switch on, advance the throttle to 1500-1600 rpm and move propeller speed lever to DECREASE RPM. Repeat this three or four times to dilute the oil in the propeller. Operate the propeller feathering button through several cycles before shutting down the engine. Release the dilute switch only after the engine stops turning.

Note

In extreme cold weather, undiluted oil in the propeller pitch-changing and feathering systems can render these systems inoperative by becoming too viscous to circulate. For this reason, during the latter part of the dilution procedure

OIL DILUTION TABLE

ANTICIPATED TEMPERATURE		DILUTION REQUIRED	OIL QUANTITY IN TANK AT START OF DILUTION	TIME TO DILUTE	
C°	F°	PERCENT	GALLONS	MIN	SEC
−1	+30	5	19.5	1	0
−7	+20	7	19	1	20
−12	+10	10	18	2	0
−18	0	14	17	3	0
−29	−20	20	14	4	0
BELOW −29	BELOW −20	30	10	6	30

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Figure 9-5

the propeller speed levers and feathering buttons are used to cause diluted oil to circulate in the pitch-changing and feathering systems.

4. If it is necessary to service the oil tank, divide the oil dilution period so that dilution is accomplished both before and after servicing. The total dilution time shall be as specified in figure 9-4.

CAUTION

To prevent engine damage by excessively rapid cooling do not shut down the engine until the cylinder head temperatures fall below 200°C. When dilution has been accomplished, it shall be noted on Form 781.

BEFORE LEAVING THE AIRPLANE

1. After wheels are chocked, release the parking brake to avoid freezing the brakes in the set position.
2. To prevent frosting of the windows (which will occur in cold weather when air is not permitted to circulate) leave an emergency escape hatch open or one of the flight compartment windows open, if possible. If the airplane is to remain unprotected overnight or for an extended period, remove the battery and store it in a warm place.
3. Empty the drinking water jug to prevent damage by freezing.

HOT WEATHER PROCEDURES

EXTERIOR INSPECTION

Check the fabric seals at the rudder and elevator leading edges for freedom from fungi. If fungi are present, clean fabric with a soft cloth.

BEFORE STARTING ENGINES

If necessary, warm electrical instruments with an external heat source until all moisture is eliminated. Operate all movable surfaces.

STARTING ENGINES

At extremely high ground temperatures, vapor lock may occur in the carburetor. If the engines will not start and run normally, they may be kept firing by using the primer until the vapor lock is dissipated.

ENGINE GROUND OPERATION

Make all possible ground checks before starting engines. Do not operate engines on the ground any longer than is absolutely necessary, as it is difficult to keep temperatures within limits during extended ground operation.

BEFORE LEAVING AIRPLANE

As soon as the engines have cooled, install weather covers. These covers will help to keep out moisture and inhibit corrosion and the growth of fungi.

DESERT PROCEDURES

EXTERIOR INSPECTION

1. If possible, conduct all engine ground operations on landing mats or on a hard surface free of sand, dust, and dirt.
2. Where possible, head the airplane into the wind to provide maximum cooling conditions when engines are running. Cylinder head temperatures will rise rapidly during engine ground operation in extreme heat.
3. Check the position of your airplane with relation to other parked aircraft. If necessary, reposition your airplane by tractor, or request that aircraft near you be moved to avoid their being sandblasted during your engine ground run. Also give the same consideration to personnel and ground installations.
4. If a portable ground cooler unit is available, have it connected at the ground air-conditioning door. With the pilots' side windshields open and all other openings closed, maximum circulation through the cabin will be provided.
5. Check that all exterior surfaces of the airplane are free of sand and dirt.
6. If sand is blowing, do not direct removal of covers from engines, nacelles, propeller blades, pitot tubes, and nose section until just before starting engines.
7. Check that main and nose gear wheel covers have been removed. Check that sand and dirt have been removed from landing gear struts, actuating cylinders, landing gear locking mechanism, wheels, and brakes. If shock struts and exposed portions of landing gear actuating cylinders are not clean, direct that they be wiped clean with a cloth moistened with hydraulic fluid, then wiped dry to prevent sand from sticking to the clean surfaces.
8. Check tires for blisters and obvious signs of deterioration from extreme heat.
9. Check all drains and vents for freedom from foreign matter and sand.

BEFORE STARTING ENGINES

1. Check rear loading door, escape hatches, and flight compartment windows to make certain they will open. Then close and secure.
2. Wipe instrument panels and dial faces free of dust and sand.
3. Direct that all remaining covers be removed (from engines, nacelles, propeller blades, pitot tubes, etc.). Direct that ground cooling ducts be disconnected.

ENGINE GROUND OPERATION

Keep duration of warmup and ground tests to a minimum. In extreme heat, observe cylinder head and carburetor air temperatures closely to avoid exceeding limits.

BEFORE TAKEOFF

Unless absolutely necessary, do not take off during sand or dust storms. Head the airplane crosswind and stop engines. Do not take off in the wake of another airplane. Wait until blowing sand and dust are at a minimum.

TAKEOFF—CLIMB

WARNING

Allow for additional takeoff run in hot weather. Hot air is less dense than cold air and the lift effect is therefore less.

Keep careful check on cylinder head and carburetor air temperatures. Do not climb at speeds less than those given in the Appendix.

CRUISE

Keep the cabin pressurization switch in AUTO position and the cabin heat rheostat turned to COLD for maximum cool air ventilation.

DESCENT

The airplane will have a greater rate of descent in extreme heat than in moderate temperatures due to the decreased lift effect of hot air.

LANDING

In extreme heat, landing distances greater than those given in the Appendix will be required due to decreased air density.

ENGINE SHUTDOWN

Park the airplane headed into the wind and located to prevent sandblasting other aircraft in the vicinity. Stop the engines as soon as possible to avoid excessive cylinder head temperature rise. Expedite postflight engine checks to avoid clouds of dust and sand.

BEFORE LEAVING THE AIRPLANE

As soon as the engines have cooled, install weather covers. Take extreme care to prevent sand or dust from entering the fuel and oil tanks during servicing. Leave pilots' compartment windows open slightly to assure air circulation.

CAUTION

- If sand or dust storms are anticipated, do not leave windows or doors open unless a crew member is available to secure the airplane when necessary. All openings must be closed during sand storms. Sand is a greater evil than heat, and every precaution must be taken to keep it out of the nacelles and cabin interior.
- If a windstorm is in progress or anticipated order that the airplane be tied down. Check that this has been accomplished before leaving the airplane.

Appendix I PERFORMANCE DATA

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*The symbol * indicates an illustration*

SCOPE AND ARRANGEMENT

The charts contained in this Appendix present the performance of the C-131A airplane in a graphical form. They are based on ICAO standard atmospheric conditions; however, nomograms are provided to allow corrections for non-standard conditions as necessary. The charts are arranged in a logical sequence in seven basic divisions for planning general phases of each flight.

PART 1—INTRODUCTION

PART 2—ENGINE DATA

PART 3—TAKEOFF

PART 4—CLIMB

PART 5—CRUISE

PART 6—APPROACH AND LANDING

PART 7—MISSION PLANNING

Descriptive text in each part discusses and explains the use of the charts provided. A sample problem at the end of the Appendix shows how the individual performance charts for each phase of a flight can be combined for flight planning purposes.

GLOSSARY OF TERMS AND ABBREVIATIONS

ABSOLUTE CEILING—Maximum altitude at which level flight can be maintained with zero feet per minute rate of climb.

ACCELERATION CHECK SPEED AND DISTANCE—The acceleration check distance is the distance from the start of takeoff to an acceleration check point. For the go-no-go concept, it is the distance to the runway marker which is 1000 feet less than the go-no-go distance marker.

AIRSPEED

IAS—Indicated airspeed; observed airspeed corrected for instrument error.

CAS—Calibrated airspeed; IAS corrected for installation error in the pitot system.

EAS—Equivalent airspeed; CAS corrected for compressibility error. For all practical purposes at altitudes below 15,000 feet, the compressibility factor is negligible for this airplane.

TAS—True airspeed; EAS corrected for relative density.

$$\text{TAS} = \text{EAS} \times \frac{1}{\sqrt{\sigma}}$$

BEST CLIMB SPEED—The airspeed which results in the best vertical velocity for a given configuration and altitude.

BHP—Brake horsepower.

CAT—Carburetor air temperature.

COLD ATMOSPHERE—Atmospheric conditions simulating extreme cold weather used for comparing airplane performance. AF cold atmosphere at sea level is represented by a barometric pressure of 29.92 in. Hg. at −60°F (−51°C).

CRITICAL ALTITUDE—The altitude at which full throttle is required to maintain a given BHP at a set RPM.

CRITICAL ENGINE FAILURE SPEED (Vcrit)—The speed at which failure of one engine permits acceleration to takeoff in the same distance that the airplane may be decelerated to a stop using brakes only.

CRITICAL FIELD LENGTH—The total length of runway required to accelerate on all engines to the critical engine failure speed, lose one engine, and then continue takeoff, or stop.

CRUISE CEILING—Maximum altitude at which a rate of climb of 300 feet per minute can be maintained with METO power.

DENSITY ALTITUDE—Pressure altitude corrected for temperature. When conditions are standard, pressure altitude and density altitude are the same. Consequently, if the temperature is above standard, the density altitude will be higher than the pressure altitude. If the temperature is below standard, the density altitude will be lower than the pressure altitude.

DEWPOINT—The temperature at which, under ordinary conditions, condensation begins in a cooling mass of air. This temperature is used as the basis for calculating the effect produced by humidity on the power output of the engines.

EXPECTED TORQUE PRESSURE—The torque pressure which the engine may be expected to develop when the effects of altitude and atmospheric conditions are considered.

GO-NO-GO SPEED AND DISTANCE—The go-no-go distance is the distance to the runway marker which is the first 1000-foot marker before the normal refusal distance (no wind). It is also the point at which the final decision to continue or abort the takeoff is made. The go-no-go speed is the minimum speed allowable at the go-no-go distance marker.

HOT ATMOSPHERE—Atmospheric conditions simulating extreme hot weather used for comparing engine and airplane performance. AF hot atmosphere at sea level is represented by a barometric pressure of 29.92 in. Hg. at 103°F (39.4°C).

LANDING DISTANCE—Distance from height of 50 feet over end of runway to completion of landing ground roll.

LANDING GROUND ROLL—Distance from touchdown to complete stop, utilizing brakes only, on a dry hard surface with propellers windmilling.

MAP—Engine absolute manifold pressure (in. Hg).

MAXIMUM DRY POWER—The maximum power permissible from the engine when the water injection system is not used; limited to five minutes.

MAXIMUM WET POWER—The maximum power permissable from the engine utilizing the water injection system; limited to five minutes.

METO (MAXIMUM EXCEPT TAKEOFF) POWER —The maximum power at which the engine can be operated continuously without damage.

MILITARY POWER—The same as maximum dry power except that the time limit is 30 minutes. An airplane engine can actually be run continuously under overload conditions of power and speed for much longer periods than those permitted by the ratings. However, the period of reliable operation is thereby reduced to an *impractically short time.* By imposing a time limit on maximum and military power ratings, the cumulative effect of the overloads is distributed evenly over the period between overhauls and the useful life of the engine accordingly lengthened. When use of military power is absolutely required for longer than 30 minutes, a notation must be made on Form 781.

MINIMUM CONTROL SPEED (V_{mc})—Speed required to provide sufficient control to enable the airplane to fly a straight flight path over the ground with takeoff configuration, one engine windmilling, maximum power on other engine and no more than 5° bank angle away from the failed engine.

MINIMUM PERFORMANCE TORQUE PRESSURE—95% of expected torque pressure.

MINIMUM SAFE SINGLE ENGINE SPEED—Speed that will permit the airplane to maintain a minimum 100 fpm rate of climb in clean configuration (sea level, standard atmosphere) with the propeller on the inoperative engine feathered and maximum power on the operating engine.

OAT (FAT)—Outside or free air temperature; denoted as runway air temperature when observed at the runway.

PRESSURE ALTITUDE—The height or vertical distance from the standard datum plane. This is a theoretical plane where air pressure is equal to 29.92 in. Hg. at 15°C (59°F).

REFUSAL SPEED (V_R)—The maximum speed to which the airplane can be accelerated and still be stopped on the remaining runway using brakes only.

RUNWAY HEADWIND COMPONENT—Resultant headwind parallel to runway, as a result of wind direction and velocity.

SIGMA (σ) = Density ratio (ρ/ρ_0). The ratio between ambient density and standard sea level density. $\frac{1}{\sqrt{\sigma}}$ is the correction factor for air density applied to EAS to obtain TAS.

SERVICE CEILING—Maximum altitude at which a rate of climb of 100 feet per minute can be maintained.

STALL SPEED (V_{STALL})—Speed at which the airplane starts to drop because of separation of airflow over the wings due to insufficient airspeed or excessive angle of attack.

STANDARD ATMOSPHERE—An arbitrary variation of air density, pressure, and temperature with altitude used for comparing engine and airplane performance. Standard air at sea level is represented by a barometric pressure of 29.92 in. Hg. at 59°F (15°C).

TAKEOFF DISTANCE—Distance from start of takeoff to takeoff speed with both engines operating.

TAKEOFF SPEED—Speed at which main wheels leave the ground.

TORQUE PRESSURE (TPSI)—An indication of power being delivered to the propeller shaft by the engine.

WIND ACCOUNTABILITY—The wind correction nomograms on the takeoff and landing charts are calculated on the basis of 100% wind accountability. Reported headwinds should be used at 50% of their value and reported tailwinds should be used at 150% of their value if the wind is measured at a source other than the runway.

DISCUSSION OF STANDARD CHARTS

The standard charts (figures A1-1 through A1-7) are provided for ready reference in determining standard and non-standard atmospheric conditions, and in determining compressibility and position error corrections to airspeed readings. For all normal flight planning compressibility effect on airspeed and altitude indication is negligible. Nevertheless, the airplane commander should study the standard charts and their limitations and be ready to apply them as necessary to satisfy any specific detail problem.

DENSITY ALTITUDE CHART

Density altitude may be found from this chart (figure A1-1), for a given temperature and pressure altitude condition.

EXAMPLE

a. Outside air temperature = 25°C.

b. Pressure altitude = 3500 feet.

c. $\frac{1}{\sqrt{\sigma}} = 1.083$.

d. Density altitude = 5400 feet.

This chart also provided a $\frac{1}{\sqrt{\sigma}}$ value necessary to change equivalent airspeed to true airspeed. Enter the chart with the given temperature condition, proceed vertically to the pressure altitude, and read horizontally to the right to obtain the $\frac{1}{\sqrt{\sigma}}$ value. True airspeed (TAS) may then be obtained from equivalent airspeed (EAS) by multiplying the given EAS by the $\frac{1}{\sqrt{\sigma}}$ value.

DENSITY ALTITUDE VERSUS $\frac{1}{\sqrt{\sigma}}$

This chart (figure A1-2) gives values of $\frac{1}{\sqrt{\sigma}}$ accurately for every 100-foot increment in density altitude.

STANDARD ATMOSPHERE TABLE

A Standard Atmosphere Table (figure A1-3) shows standard atmospheric values as defined by ICAO. The standard atmosphere defined by ICAO represents an approximation to the average atmosphere of the world. The ICAO assumes a temperature of 15°C (59°F) and a pressure of 29.92 in. Hg. for sea level conditions. The temperature variation with height is approximately uniform from 15°C (59°F) at sea level to −56.5°C (−69.7°F) at 36,089 feet. This altitude is assumed to be the beginning of the isothermal region or stratosphere. For all practical purposes the temperature will remain constant as altitude is increased above 36,089 feet. The corresponding pressures and densities are shown on the Standard Atmosphere Table. ICAO standard atmosphere values have been used in preparation of all performance charts in this Appendix. Data for nonstandard conditions are shown as variations from the ICAO standard atmosphere.

PRESSURE ALTITUDE TABLE

The Pressure Altitude Table (figure A1-4) provides the necessary corrections to field elevation to obtain pressure altitude from the altimeter setting. To determine pressure altitude, find the altitude correction (Δ ALT) for the given altimeter setting. Add this correction algebraically to the field elevation to obtain pressure altitude.

TEMPERATURE CONVERSION CHART

The Temperature Conversion Chart (figure A1-5) is presented in degrees centigrade versus degrees fahrenheit to facilitate the conversion of given temperatures as desired.

AIRSPEED CALIBRATION

Airspeed Calibration (figure A1-6) for the airspeed system shows indicated airspeed versus calibrated airspeed to account for the location of the static pressure pickup. The effects of airplane attitude are negligible to the position error in terms of wing flap setting, landing gear position, and gross weight.

AIRSPEED COMPRESSIBILITY CORRECTION CHART

This chart (figure A1-7) presents calibrated airspeed versus equivalent airspeed to account for the compressibility of the atmosphere.

ALTIMETER POSITION ERROR CORRECTION

Altimeter errors due to static port location are negligible and no correction is necessary.

DENSITY ALTITUDE CHART

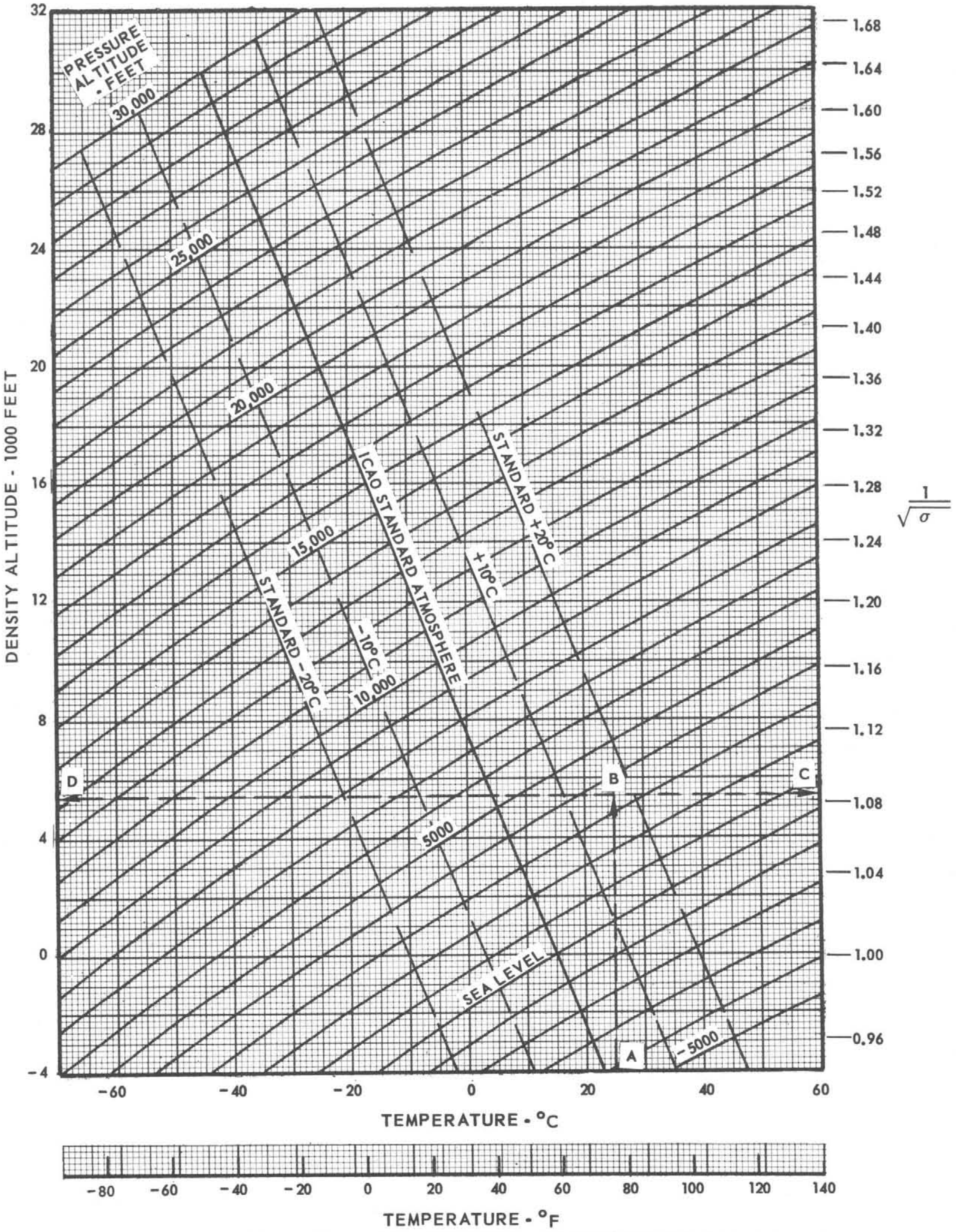


Figure A1-1

DENSITY ALTITUDE VS $\frac{1}{\sqrt{\sigma}}$

TRUE AIRSPEED = EQUIVALENT AIRSPEED × $\frac{1}{\sqrt{\sigma}}$

DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$	DENSITY ALTITUDE (FEET)	$\frac{1}{\sqrt{\sigma}}$
100	1.0014	3300	1.0501	6500	1.1023	9700	1.1582	12900	1.2186	16100	1.2837	19300	1.3541	22400	1.4277
200	1.0029	3400	1.0516	6600	1.1039	9800	1.1600	13000	1.2206	16200	1.2858	19400	1.3564	22500	1.4302
300	1.0044	3500	1.0531	6700	1.1056	9900	1.1618	13100	1.2225	16300	1.2879	19500	1.3587	22600	1.4327
400	1.0059	3600	1.0548	6800	1.1073	10000	1.1637	13200	1.2245	16400	1.2901	19600	1.3609	22700	1.4351
500	1.0074	3700	1.0563	6900	1.1090	10100	1.1655	13300	1.2265	16500	1.2922	19700	1.3632	22800	1.4376
600	1.0088	3800	1.0579	7000	1.1107	10200	1.1674	13400	1.2285	16600	1.2943	19800	1.3655	22900	1.4401
700	1.0103	3900	1.0595	7100	1.1124	10300	1.1692	13500	1.2305	16700	1.2965	19900	1.3678	23000	1.4426
800	1.0118	4000	1.0611	7200	1.1141	10400	1.1711	13600	1.2324	16800	1.2986	20000	1.3701	23100	1.4451
900	1.0133	4100	1.0627	7300	1.1158	10500	1.1729	13700	1.2337	16900	1.3007	20100	1.3724	23200	1.4477
1000	1.0148	4200	1.0643	7400	1.1176	10600	1.1748	13800	1.2364	17000	1.3029	20200	1.3748	23300	1.4502
1100	1.0163	4300	1.0659	7500	1.1193	10700	1.1766	13900	1.2385	17100	1.3050	20300	1.3771	23400	1.4528
1200	1.0178	4400	1.0675	7600	1.1210	10800	1.1785	14000	1.2404	17200	1.3072	20400	1.3795	23500	1.4553
1300	1.0193	4500	1.0692	7700	1.1228	10900	1.1803	14100	1.2424	17300	1.3094	20500	1.3819	23600	1.4579
1400	1.0208	4600	1.0707	7800	1.1245	11000	1.1822	14200	1.2444	17400	1.3116	20600	1.3842	23700	1.4604
1500	1.0223	4700	1.0724	7900	1.1262	11100	1.1841	14300	1.2465	17500	1.3138	20700	1.3866	23800	1.4630
1600	1.0238	4800	1.0704	8000	1.1280	11200	1.1860	14400	1.2485	17600	1.3159	20800	1.3889	23900	1.4656
1700	1.0253	4900	1.0756	8100	1.1297	11300	1.1879	14500	1.2506	17700	1.3181	20900	1.3913	24000	1.4681
1800	1.0268	5000	1.0773	8200	1.1315	11400	1.1893	14600	1.2526	17800	1.3203	21000	1.3937	24100	1.4706
1900	1.0283	5100	1.0789	8300	1.1332	11500	1.1917	14700	1.2546	17900	1.3225	21100	1.3961	24200	1.4732
2000	1.0299	5200	1.0806	8400	1.1350	11600	1.1926	14800	1.2567	18000	1.3247	21200	1.3985	24300	1.4758
2100	1.0314	5300	1.0822	8500	1.1368	11700	1.1955	14900	1.2587	18100	1.3267	21300	1.4009	24400	1.4784
2200	1.0329	5400	1.0839	8600	1.1385	11800	1.1974	15000	1.2608	18200	1.3292	21400	1.4033	24500	1.4810
2300	1.0344	5500	1.0855	8700	1.1403	11900	1.1993	15100	1.2628	18300	1.3314	21500	1.4068	24600	1.4836
2400	1.0360	5600	1.0872	8800	1.1420	12000	1.2012	15200	1.2649	18400	1.3337	21600	1.4082	24700	1.4862
2500	1.0375	5700	1.0888	8900	1.1438	12100	1.2031	15300	1.2670	18500	1.3360	21700	1.4106	24800	1.4888
2600	1.0390	5800	1.0905	9000	1.1456	12200	1.2050	15400	1.2691	18600	1.3382	21800	1.4130	24900	1.4914
2700	1.0406	5900	1.0921	9100	1.1474	12300	1.2070	15500	1.2712	18700	1.3405	21900	1.4154	25000	1.4940
2800	1.0421	6000	1.0936	9200	1.1492	12400	1.2089	15600	1.2732	18800	1.3427	22000	1.4179		
2900	1.0436	6100	1.0954	9300	1.1510	12500	1.2109	15700	1.2753	18900	1.3450	22100	1.4203		
3000	1.0454	6200	1.0971	9400	1.1528	12600	1.2128	15800	1.2774	19000	1.3473	22200	1.4228		
3100	1.0469	6300	1.0988	9500	1.1546	12700	1.2147	15900	1.2795	19100	1.3493	22300	1.4253		
3200	1.0485	6400	1.1005	9600	1.1564	12800	1.2167	16000	1.2816	19200	1.3518				

46,256

Figure A1-2

STANDARD ATMOSPHERE TABLE

STANDARD SL CONDITIONS:
TEMPERATURE=15°C (59°F)
PRESSURE=29.921 IN. Hg (2116.216 LB/SQ FT)
DENSITY=.0023769 SLUGS/CU FT
SPEED OF SOUND=1116.89 FT/SEC (661.7 KNOTS)

CONVERSION FACTORS:
1 IN. Hg=70.727 LB/SQ FT
1 IN. Hg=0.49116 LB/SQ IN.
1 KNOT=1.151 MPH
1 KNOT=1.688 FT/SEC

ALTITUDE FEET	DENSITY RATIO σ	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE		SPEED OF SOUND KNOTS	PRESSURE IN Hg	PRESSURE RATIO δ
			°C	°F			
SL	1.000	1.0000	15.000	59.000	661.7	29.921	1.0000
1,000	.9711	1.0148	13.019	55.434	659.5	28.856	.9644
2,000	.9428	1.0299	11.038	51.868	657.2	27.821	.9298
3,000	.9151	1.0454	9.056	48.302	654.9	26.817	.8962
4,000	.8881	1.0611	7.076	44.735	652.6	25.842	.8637
5,000	.8617	1.0773	5.094	41.169	650.3	24.896	.8320
6,000	.8359	1.0938	3.113	37.603	648.7	23.978	.8014
7,000	.8106	1.1107	1.132	34.037	645.6	23.088	.7716
8,000	.7860	1.1279	—0.850	30.471	643.3	22.225	.7428
9,000	.7620	1.1456	—2.831	26.905	640.9	21.388	.7148
10,000	.7385	1.1637	—4.812	23.338	638.6	20.577	.6877
11,000	.7155	1.1822	—6.793	19.772	636.2	19.791	.6614
12,000	.6932	1.2011	—8.774	16.206	633.9	19.029	.6360
13,000	.6713	1.2205	—10.756	12.640	631.5	18.292	.6113
14,000	.6500	1.2403	—12.737	9.074	629.0	17.577	.5875
15,000	.6292	1.2606	—14.718	5.508	626.6	16.886	.5643
16,000	.6090	1.2815	—16.699	1.941	624.2	16.216	.5420
17,000	.5892	1.3028	—18.680	—1.625	621.8	15.569	.5203
18,000	.5699	1.3246	—20.662	—5.191	619.4	14.942	.4994
19,000	.5511	1.3470	—22.643	—8.757	617.0	14.336	.4791
20,000	.5328	1.3700	—24.624	—12.323	614.6	13.750	.4595
21,000	.5150	1.3935	—26.605	—15.889	612.1	13.184	.4406
22,000	.4976	1.4176	—28.587	—19.456	609.6	12.636	.4223
23,000	.4806	1.4424	—30.568	—23.022	607.1	12.107	.4046
24,000	.4642	1.4678	—22.549	—26.588	604.6	11.597	.3876
25,000	.4481	1.4938	—34.530	—30.154	602.1	11.103	.3711
26,000	.4325	1.5206	—36.511	—33.720	599.6	10.627	.3552
27,000	.4173	1.5480	—38.492	—37.286	597.1	10.168	.3398
28,000	.4025	1.5762	—40.474	—40.852	594.6	9.725	.3250
29,000	.3881	1.6052	—42.455	—44.419	592.1	9.297	.3107
30,000	.3741	1.6349	—44.436	—47.985	589.5	8.885	.2970
31,000	.3605	1.6654	—46.417	—51.551	586.9	8.488	.2837
32,000	.3473	1.6968	—48.398	—55.117	584.4	8.106	.2709
33,000	.3345	1.7291	—50.379	—58.683	581.8	7.737	.2586
34,000	.3220	1.7623	—52.361	—62.249	579.2	7.382	.2467
35,000	.3099	1.7964	—54.342	—65.816	576.6	7.041	.2353
36,000	.2981	1.8315	—56.323	—69.382	574.0	6.712	.2243
36,089	.2791	1.8347	—56.500	—69.700	573.7	6.683	.2234
37,000	.2843	1.8753	↓	↓	↓	6.397	.2138
38,000	.2710	1.9209	↓	↓	↓	6.097	.2038
39,000	.2583	1.9677	↓	↓	↓	5.811	.1942
40,000	.2462	2.0155	—56.500	—69.700	573.7	5.538	.1851

22008-1B

Figure A1-3

PRESSURE ALTITUDE TABLE

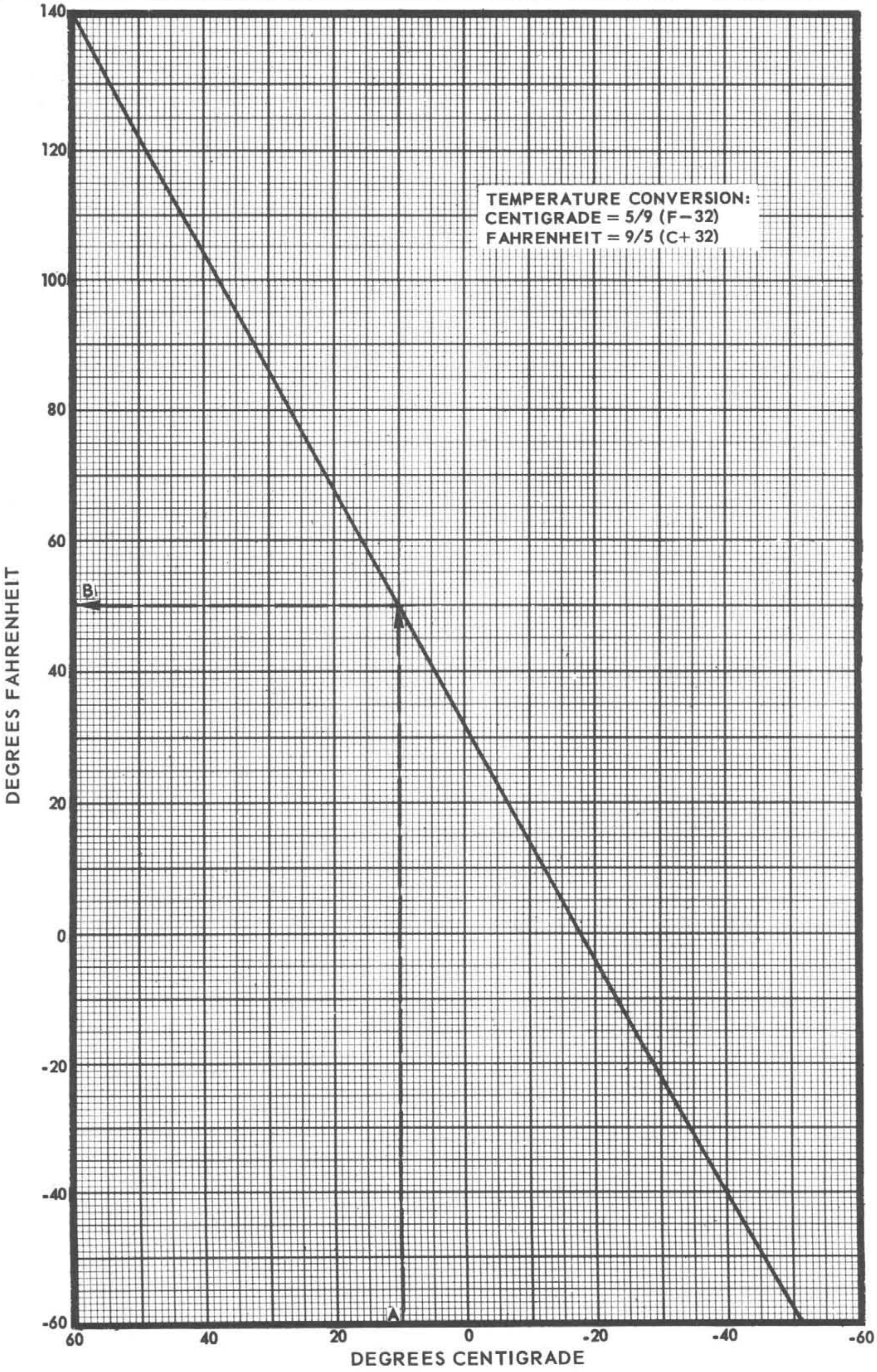
PRESSURE ALTITUDE = FIELD ELEVATION + △ ALTITUDE

ALTI-METER SETTING IN. HG	△ ALT FT	ALTI-METER SETTING IN. HG	△ ALT FT	ALTI-METER SETTING IN. HG	△ ALT FT	ALTI-METER SETTING IN. HG	△ ALT FT	ALTI-METER SETTING IN. HG	△ ALT FT	ALTI-METER SETTING IN. HG	△ ALT FT	ALTI-METER SETTING IN. HG	△ ALT FT
28.00	1824	28.50	1340	29.00	863	29.50	392	30.00	−73	30.50	−531	31.00	−983
.01	1814	.51	1330	.01	853	.51	382	.01	−82	.51	−540	.01	−992
.02	1805	.52	1321	.02	844	.52	373	.02	−91	.52	−549	.02	−1001
.03	1795	.53	1311	.03	834	.53	364	.03	−100	.53	−558	.03	−1010
.04	1785	.54	1302	.04	825	.54	354	.04	−110	.54	−567	.04	−1019
.05	1776	.55	1292	.05	815	.55	345	.05	−119	.55	−576	.05	−1028
.06	1766	.56	1282	.06	806	.56	336	.06	−128	.56	−585	.06	−1037
.07	1756	.57	1273	.07	796	.57	326	.07	−137	.57	−594	.07	−1046
.08	1746	.58	1263	.08	787	.58	318	.08	−146	.58	−604	.08	−1055
.09	1737	.59	1254	.09	777	.59	308	.09	−156	.59	−613	.09	−1064
28.10	1727	28.60	1244	29.10	768	29.60	298	30.10	−165	30.60	−622	32.00	−1073
.11	1717	.61	1234	.11	758	.61	289	.11	−174	.61	−631		
.12	1707	.62	1225	.12	749	.62	280	.12	−183	.62	−640		
.13	1698	.63	1215	.13	739	.63	270	.13	−192	.63	−649		
.14	1688	.64	1206	.14	730	.64	261	.14	−202	.64	−658		
.15	1678	.65	1196	.15	721	.65	252	.15	−211	.65	−667		
.16	1668	.66	1186	.16	711	.66	242	.16	−220	.66	−676		
.17	1659	.67	1177	.17	702	.67	233	.17	−229	.67	−685		
.18	1649	.68	1167	.18	692	.68	224	.18	−238	.68	−694		
.19	1639	.69	1158	.19	683	.69	215	.19	−248	.69	−703		
28.20	1630	28.70	1148	29.20	673	29.70	205	30.20	−257	30.70	−712		
.21	1620	.71	1139	.21	664	.71	196	.21	−266	.71	−721		
.22	1610	.72	1129	.22	655	.72	187	.22	−275	.72	−730		
.23	1601	.73	1120	.23	645	.73	177	.23	−284	.73	−740		
.24	1591	.74	1110	.24	636	.74	168	.24	−293	.74	−749		
.25	1581	.75	1100	.25	626	.75	159	.25	−303	.75	−758		
.26	1572	.76	1091	.26	617	.76	149	.26	−312	.76	−767		
.27	1562	.77	1081	.27	607	.77	140	.27	−321	.77	−776		
.28	1552	.78	1072	.28	598	.78	131	.28	−330	.78	−785		
.29	1542	.79	1062	.29	589	.79	122	.29	−339	.79	−794		
28.30	1533	28.80	1053	29.30	579	29.80	112	30.30	−348	30.80	−803		
.31	1523	.81	1043	.31	570	.81	103	.31	−358	.81	−812		
.32	1513	.82	1034	.32	560	.82	94	.32	−367	.82	−821		
.33	1504	.83	1024	.33	551	.83	85	.33	−376	.83	−830		
.34	1494	.84	1015	.34	542	.84	75	.34	−385	.84	−839		
.35	1484	.85	1005	.35	532	.85	66	.35	−394	.85	−848		
.36	1475	.86	995	.36	523	.86	57	.36	−403	.86	−857		
.37	1465	.87	986	.37	514	.87	47	.37	−412	.87	−866		
.38	1456	.88	976	.38	504	.88	38	.38	−421	.88	−875		
.39	1446	.89	967	.39	495	.89	29	.39	−431	.89	−884		
28.40	1436	28.90	957	29.40	485	29.90	20	30.40	−440	30.90	−893		
.41	1427	.91	948	.41	476	.91	10	.41	−449	.91	−902		
.42	1417	.92	938	.42	467	.92	1	.42	−458	.92	−911		
.43	1407	.93	929	.43	457	.93	−8	.43	−467	.93	−920		
.44	1398	.94	919	.44	448	.94	−17	.44	−476	.94	−929		
.45	1388	.95	910	.45	439	.95	−26	.45	−485	.95	−938		
.46	1378	.96	900	.46	429	.96	−36	.46	−494	.96	−947		
.47	1369	.97	891	.47	420	.97	−45	.47	−504	.97	−956		
.48	1359	.98	881	.48	410	.98	−54	.48	−513	.98	−965		
.49	1350	.99	872	.49	401	.99	−63	.49	−522	.99	−974		

46,257

Figure A1-4

TEMPERATURE CONVERSION CHART



TEMPERATURE CONVERSION:
CENTIGRADE = 5/9 (F−32)
FAHRENHEIT = 9/5 (C+32)

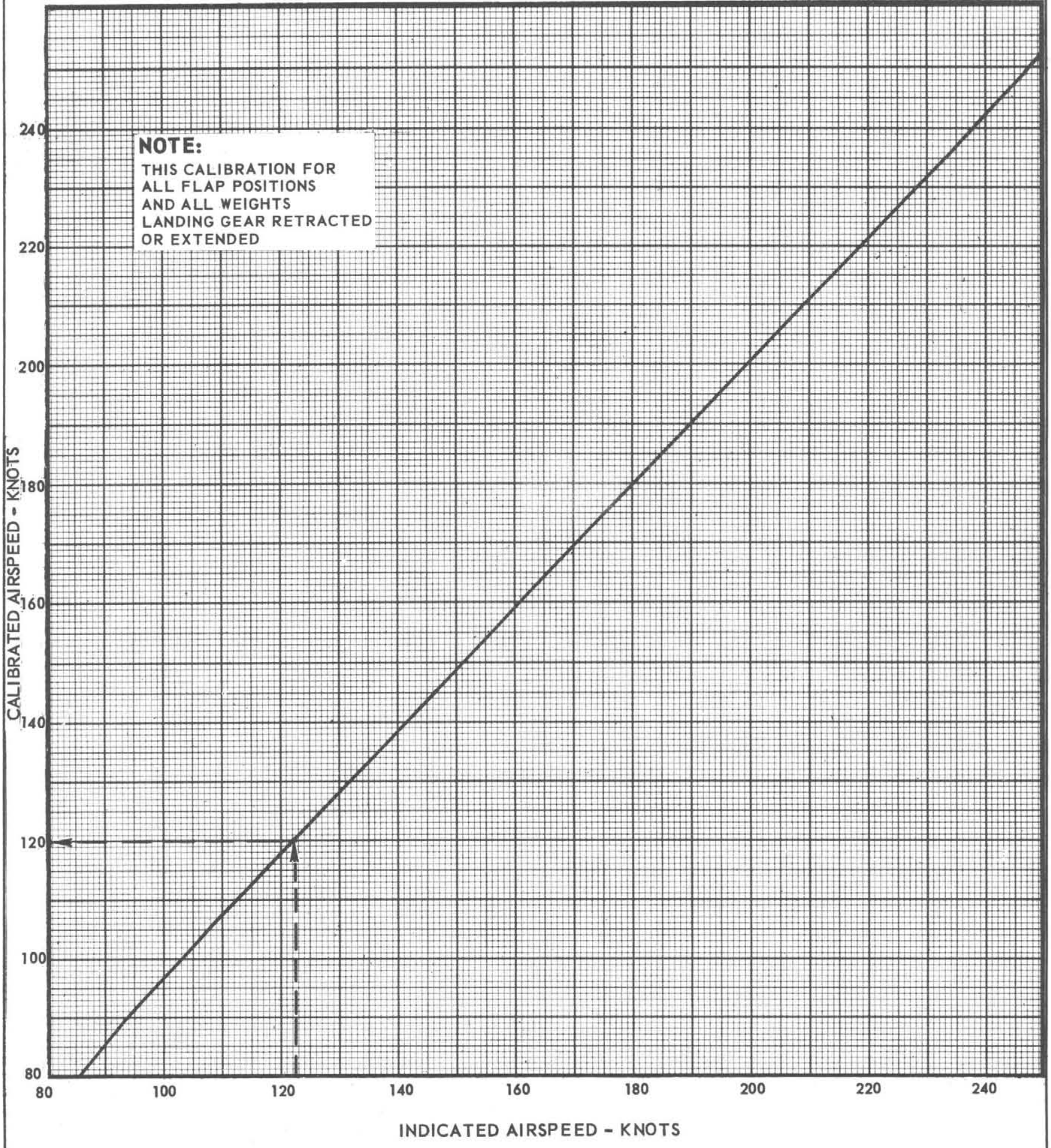
46,258

Figure A1-5

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

AIRSPEED CALIBRATION

ENGINES: R2800-99W

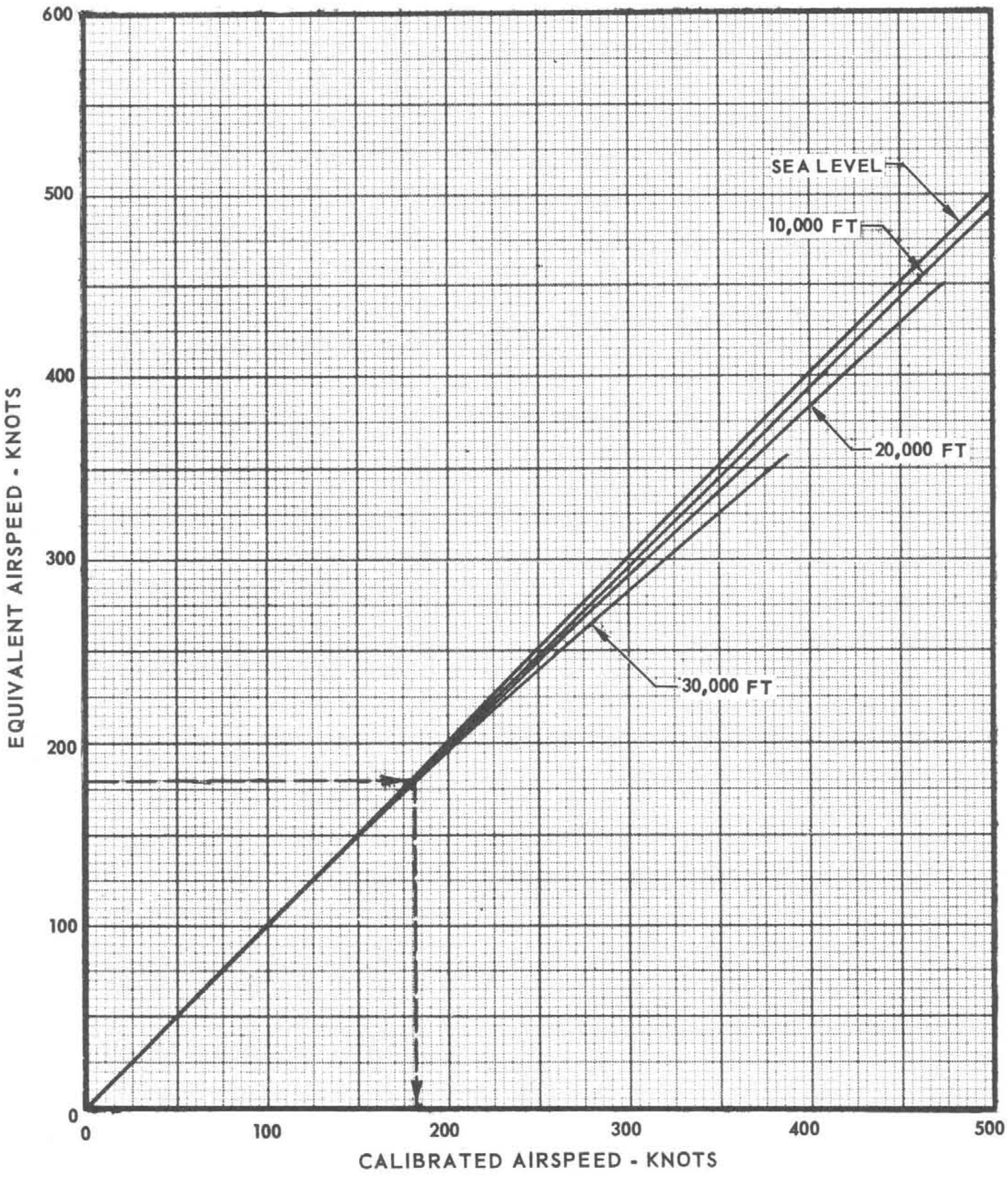


NOTE:
THIS CALIBRATION FOR
ALL FLAP POSITIONS
AND ALL WEIGHTS
LANDING GEAR RETRACTED
OR EXTENDED

24,174A

Figure A1-6

AIRSPEED COMPRESSIBILITY CORRECTION



45502B

Figure A1-7

PART 2—ENGINE DATA

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*The symbol * indicates an illustration*

ENGINE DATA

ENGINE POWER TIME LIMITATIONS

The engines are approved by the manufacturer for five minutes of operation at maximum wet power, five minutes at maximum dry power, and 30 minutes at MILITARY power. There is no time limit for operations at METO power or less. Maximum power is determined during the normal preflight planning by reference to the maximum power available curves.

ENGINE RATINGS, LIMITS, AND THE CONTROL OF POWER

The standard engine ratings are Maximum Wet, Maximum Dry, Military, and METO. Each is expressed in terms of power (bhp), engine speed (rpm) and pressure altitude (ft above sea level). The operating limits which apply to each rating include such variables as spark advance, mixture strength, manifold pressure, torque pressure, carburetor air temperature, cylinder head temperature, oil inlet temperature, oil pressure and fuel pressure. These limits must be observed individually and collectively to stay within the envelope of conditions which determines reliable engine performance, and to avoid malfunction. For power settings below the engine ratings, such as those used for climb and cruise flight, the operating limits are conservative from the viewpoint of engine reliability and are set to achieve long engine life and economical maintenance. The control of power is established primarily by setting rpm and manifold pressure. Power available curves and power charts show the rpm and manifold pressure required for the full range of engine performance under specific operating conditions. The charts show a range of carburetor air temperature and the manifold pressure required to obtain a selected power corrected to the observed temperature conditions. This correction for nonstandard conditions of carburetor air temperature amounts to an increase in manifold pressure of approximately 1.0 percent for each 5.5°C that the temperature exceeds standard altitude temperature (15°C at sea level). If the carburetor air temperature is colder than standard, a corresponding decrease in manifold pressure is shown for accurate power setting. The rules for application of this manifold pressure correction vary depending on the power level and on the operating condition. The maximum manifold pressure specified for each of the engine ratings is regarded as a never-exceed limit under all operating conditions. These limits appear in Section V and on the power available charts. This means that no upward correction to manifold pressure is allowed at any of the standard engine ratings to compensate for power loss due to hotter than standard temperature conditions. For takeoff in colder than standard conditions (with carburetor air temperatures below 15°C) and particularly under extremely cold arctic conditions, it is desirable to avoid overpowering the engine beyond its ratings. Occasional torque pressure indications in moderate excess of the value corresponding to maximum power should not be cause for concern. However, it is desirable to avoid exceeding the maximum power torque pressure by more than 3 percent. Two alternate procedures for adjusting power at the engine ratings are suggested under cold weather conditions: (1) Reduce the takeoff manifold pressure approximately 1.0 inch Hg for each 10°C below standard carburetor air temperature (15°C at sea level). (2) Observe both manifold pressure and torque pressure as a limit, adjusting the throttle to whichever limit occurs first. The torque pressure limit established should account for normal tolerances of accuracy to torque-meter instrumentation and should make allowance for engine accessory power requirements by subtracting this amount (four psi for right engine) from the maximum allowable torque pressure. At lower power levels, below the engine ratings, such as at climb and cruise power settings, manifold pressure has been corrected either up or down for variation of carburetor air temperature from standard altitude air temperature in accordance with the methods outlined above. Once the correct manifold pressure is established, it is usually regarded as a maximum operating limit to avoid the possibility of over-boosting a malfunctioning engine. At these power settings, torque pressure can also be used as a limit in conjunction with manifold pressure.

RECOMMENDED CONTINUOUS CRUISE OPERATION

It is permissible to use up to METO power for continuous cruise operation; however, this procedure yields range values that are considerably less than maximum. A detailed study of the power charts and the endurance summary chart reveals that optimum cruise performance requires a gradual increase in cruise altitude as the flight progresses. The optimum cruise profile can be attained by using altitude and airspeed as the most important cruise parameters, while using the MAP, TPSI, rpm, and fuel flow indication only to monitor the engine operation. For best airplane performance at a given altitude, engine controls must be adjusted so that a gradual decrease in power is accomplished. If the predetermined BHP, as defined by the cruise charts, does not give the recommended cruise airspeed, then the MAP should be adjusted until the correct airspeed is obtained. Do not exceed engine operating limits in making this adjustment.

DISCUSSION OF CHARTS

MAXIMUM POWER AVAILABLE

The maximum power available charts (figures A2-1 through A2-5) include nomograms correcting engine delivered power to nonstandard conditions both with and without water-alcohol injection (wet or dry) for normal fuel grade 115/145 and alternate fuel grade 100/130. The charts show the maximum power available for given conditions of pressure altitude, CAT., and dew point temperature. An expected TPSI scale is included and a minimum performance TPSI scale which incorporates a 5% margin for operational use. Any increase in this 5% difference between expected TPSI and minimum performance TPSI can be used only with the approval of the commander. The maximum power available charts are based upon operation at 2800 rpm and full throttle except where manifold pressure (MAP) is limited by the engine manufacturer's recommendations. In operation at higher elevations, use all available power, but do not exceed limits. An Alternate Maximum Power Available Chart is based on operation at 2700 rpm when using alternate fuel grade 100/130.

CAUTION

For takeoff in colder than standard conditions (with carburetor air temperature below 15°C sea level) avoid overboosting the engines beyond their ratings. Observe torque pressure limits during takeoff and reduce manifold pressure approximately 0.5 inch Hg. for each 5° below standard CAT (15°C sea level). A nomogram above the maximum power limit on each chart provides the necessary correction to manifold pressure for colder than standard conditions.

The maximum power available curves are to be used to determine the minimum performance TPSI for computing takeoff performance. These computations are to be accomplished as a part of the preflight planning.

EXAMPLE

Given:

CAT (OAT+1°C)=20°C.

Pressure altitude=3500 feet.

Dew Point=55°F.

Power condition=Wet, 2800 rpm, AUTO RICH.

Note

The values of OAT should be obtained whenever possible from the tower. Indicated OAT is less desirable because of radiation effects when the airplane is on the ground.

Select the proper power available curve (figure A2-1). Enter the chart at pressure altitude of 3500 feet (A) and read up to CAT of 20° (B). Note manifold pressure 58 in. Hg. at full throttle. Read across to dew point base line and parallel guide line to 55°F, corrected for altitude (C). Read across to find expected TPSI 128 (D); and minimum performance TPSI 122 (E).

Note

If the BHP obtained by the chart is greater than the limiting BHP because of CAT below standard conditions, proceed horizontally to the MAP correction nomogram (A). Parallel the guide lines to the limiting BHP and TPSI (B), then vertically to read MAP correction for low CAT (C).

METO POWER AVAILABLE

The METO power available charts (figures A2-5A and A2-5B) present METO power (2600 rpm) for normal fuel grade 115/145 and alternate fuel grade 100/130. These charts are similar to the maximum power available charts but are extended to show low and high blower operation.

MANIFOLD PRESSURE LIMITS

A manifold pressure limits curve (figure A2-6) is presented to determine the limiting manifold pressure that can be used with any given rpm. Curves for MANUAL LEAN and AUTO RICH operation in HIGH or LOW blower at various rpm and pressure altitude values are provided. This chart may be used to cross-check MAP settings when power settings are changed during climb or cruise.

CLIMB POWER SCHEDULES

Two climb power schedules (figures A2-7 and A2-8) are presented for use in establishing power for two engine operational climb at 1400 BHP/ENG, 2400 rpm and METO Power (2600 rpm). These tables are based on operating with AUTO RICH mixture setting.

POWER SCHEDULES

Power schedules (figures A2-9 through A2-24) are presented in tabular form in increments of 100 BHP for a range of cruise powers from 500 BHP to 1700 BHP. Each schedule presents the manifold pressure, blower setting, and rpm necessary to maintain a constant BHP under various conditions of pressure altitude and carburetor air temperature. In addition, the schedules provide the TPSI and fuel flow which should be obtained when the mixture is manually leaned at cruise power settings of 1200 BHP (low blower) and below. For climb power settings above 1200 BHP in high blower, the minimum fuel flow figures represent the fuel flow tolerance of the carburetor based on engine manufacturer's data. The desired fuel flow values are based on flight tests and represent the fuel flow obtained by manually adjusting the mixture.

Note

In cases where appreciable power losses are encountered due to carburetors running too rich, the mixture may be manually adjusted to correct the power deficiency. If the mixture is manually adjusted to correct such a power deficiency, the resulting fuel flow must never be less than the applicable minimum fuel flow at the designated power setting.

The power schedules are based upon operating both engines at the same rpm and MAP. This procedure results in slightly different horsepower being delivered to each propeller, and a little less than maximum performance from the airplane, because of the unbalanced accessory loads in the engines. The right engine carries the additional load of the cabin compressor. These effects are small, however, and are not likely to cause a noticeable difference in control or performance. Since any particular combination of blower setting and rpm may be associated with many different manifold pressure values (depending on pressure altitude and carburetor air temperature), a heavy line across the table separates the HIGH and LOW blower positions and light lines are used to separate the different rpm values. To use the schedules, enter the table at the pressure altitude and read the manifold pressure horizontally to the right under the appropriate carburetor air temperature. Then follow the rpm lines and read the blower position, rpm, TPSI, and fuel flow to the right in the same rpm channel.

EFFECT OF RAM. In flight, at a given indicated airspeed, an effective boost is given to the quantity of air received by the induction system. This increase is commonly referred to as ram. The effect is the same as an increase to whatever supercharging is produced by the engine blower. The engine manufacturer's data used in preparing the power schedules do not include the effects of ram. The full throttle settings given in the tables will not be at the full throttle position under flight conditions due to the effect of ram. At a given altitude, rpm and full throttle position, the BHP developed will be increased in proportion to the amount of ram. Also if the BHP is held constant the effect of ram will increase the altitude at which this power can be developed at the full throttle position.

FUEL FLOW PER ENGINE

Fuel flow per engine charts (figures A2-25 and A2-26) are presented to determine fuel flow, corresponding to any selected brake horsepower. Curves for manual lean and manual adjust operation in high or low blower at various rpm values are provided. The desired fuel flows on these charts were obtained by flight test and are approximately 5% richer than the engine manufacturer's minimum fuel flow listed on the power schedules.

EXAMPLE

Given:

BHP per engine = 800 bhp.

RPM = 1800.

Blower = LOW.

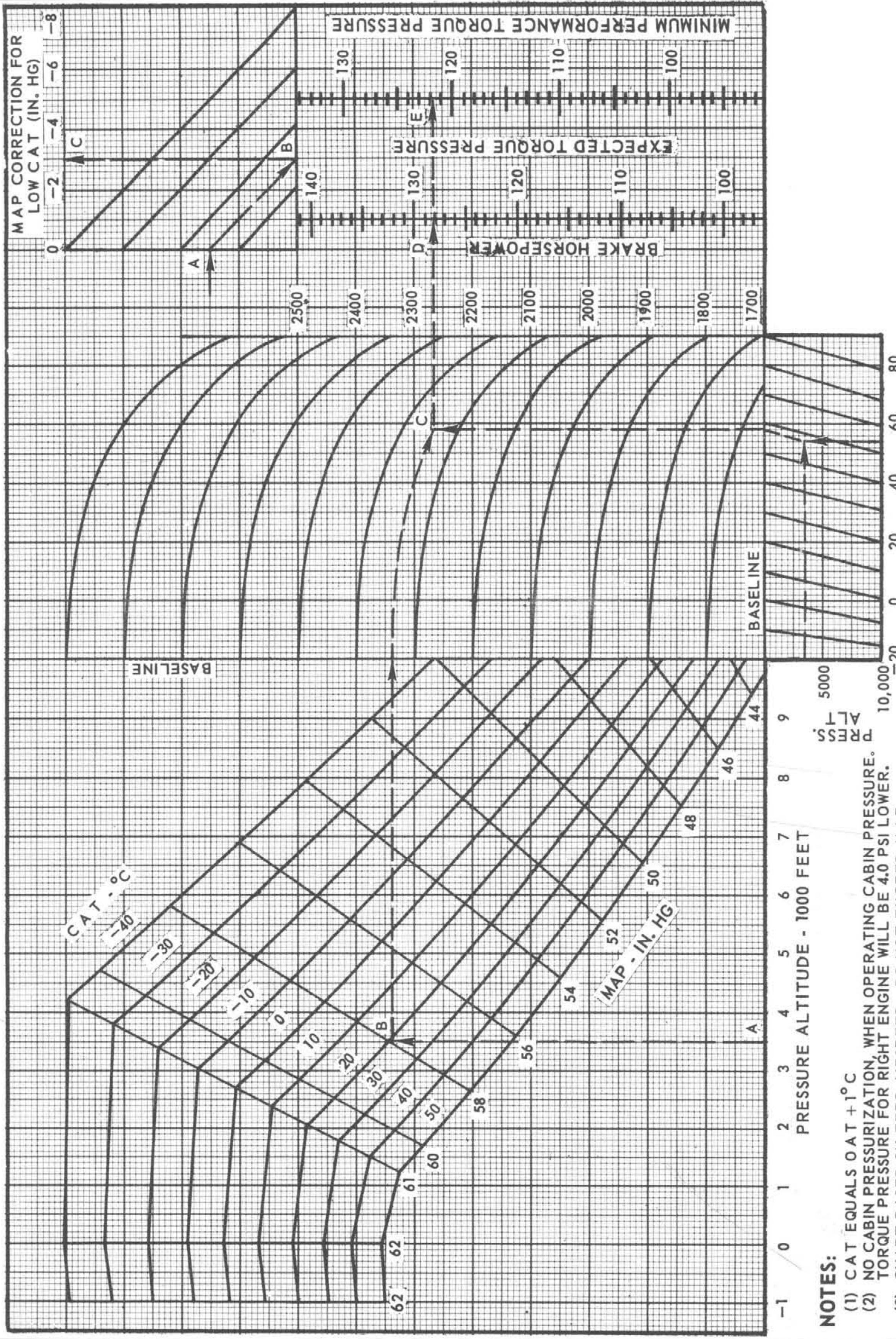
Enter chart (figure A2-25) at 800 bhp (A) and read up to rpm 1800 (B). Read across to the left and read fuel flow 364 pph (C). Note that mixture is manual lean from best power.

MAXIMUM WET POWER AVAILABLE

LOW BLOWER 2800 RPM AUTO RICH
FUEL GRADE: 115/145

MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: **FLIGHT TEST**

ENGINES: R2800-99W



NOTES:

(1) CAT EQUALS OAT +1°C
(2) NO CABIN PRESSURIZATION. WHEN OPERATING CABIN PRESSURE, TORQUE PRESSURE FOR RIGHT ENGINE WILL BE 4.0 PSI LOWER.
(3) CHART BASED ON ZERO AIRSPEED. DO NOT EXCEED MAP LIMIT DURING TAKEOFF.

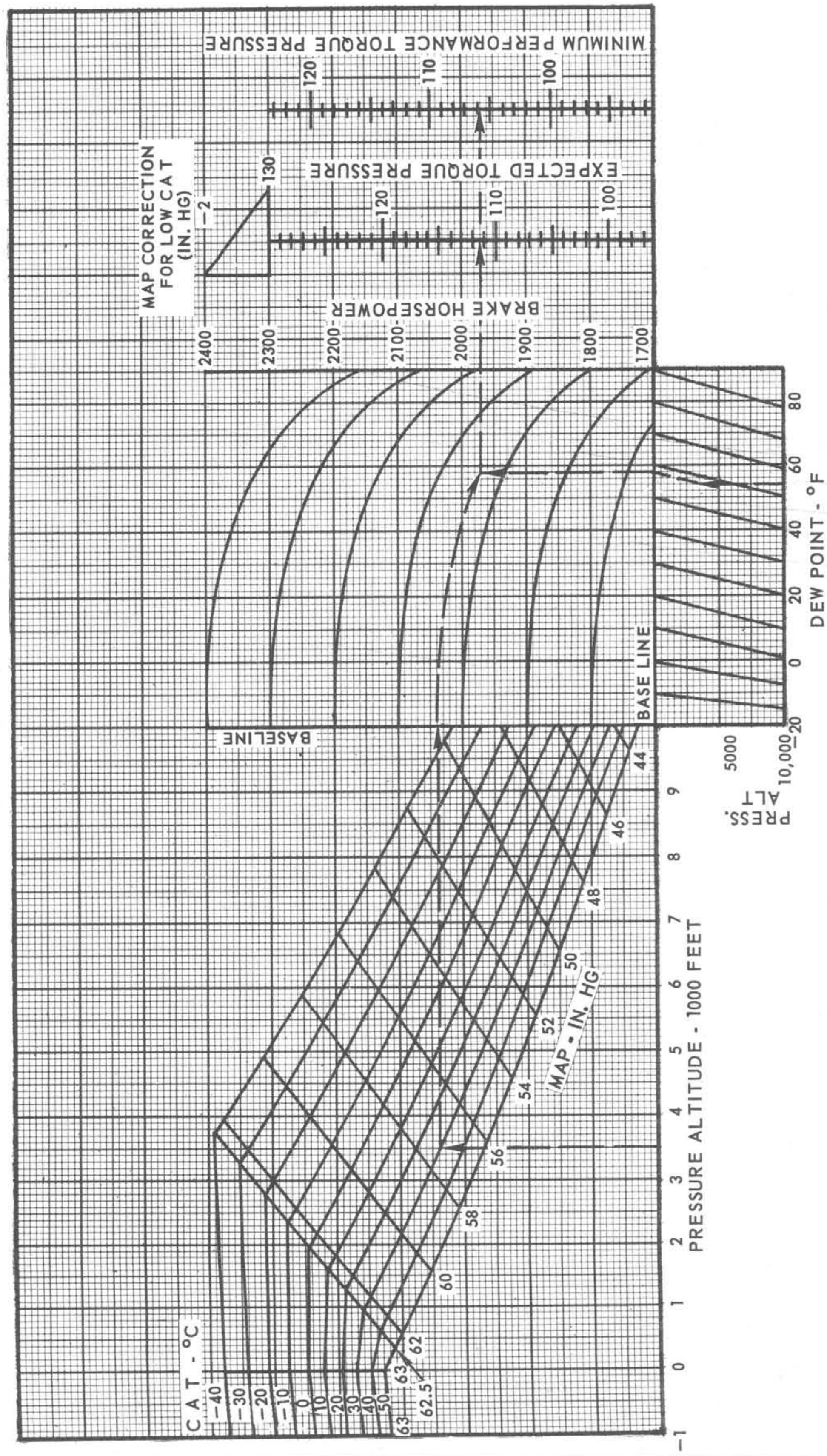
Figure A2-1

MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: **FLIGHT TEST**

MAXIMUM DRY POWER AVAILABLE

LOW BLOWER 2800 RPM AUTO RICH
FUEL GRADE: 115/145

ENGINES: R2800-99W



NOTES: (1) CAT EQUALS OAT + 1°C.
(2) WHEN USING CABIN PRESSURIZATION TORQUE PRESSURE FOR RIGHT ENGINE WILL BE 4.0 PSI LOWER.
(3) CHART BASED ON ZERO AIRSPEED. DO NOT EXCEED MAP LIMITS DURING TAKEOFF.

24, 175B

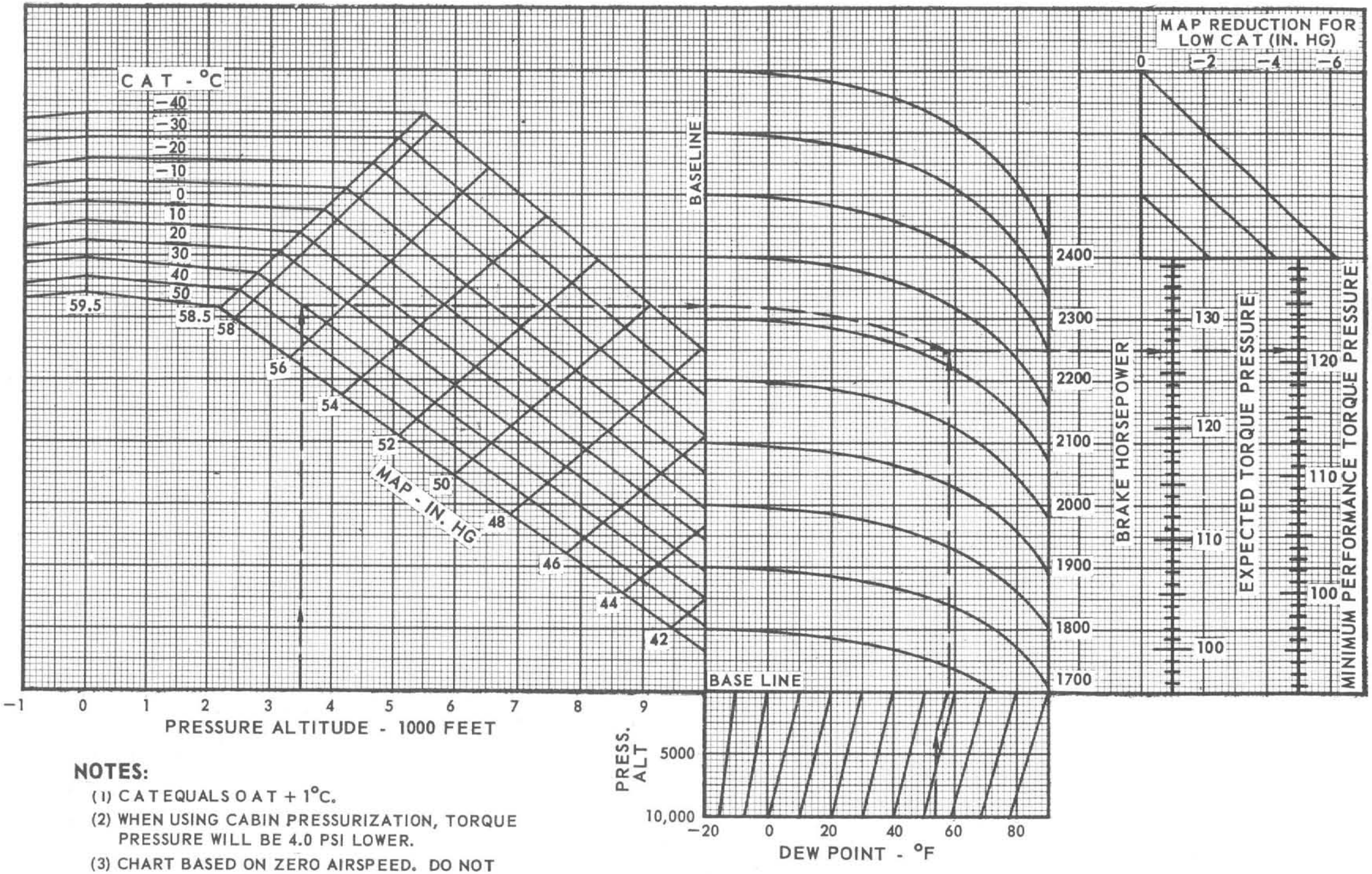
Figure A2-2

MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: **FLIGHT TEST**

MAXIMUM WET POWER AVAILABLE

LOW BLOWER 2800 RPM AUTO RICH
FUEL GRADE: 100/130

ENGINES: R2800-99W



NOTES:

(1) CAT EQUALS OAT + 1°C.

(2) WHEN USING CABIN PRESSURIZATION, TORQUE PRESSURE WILL BE 4.0 PSI LOWER.

(3) CHART BASED ON ZERO AIRSPEED. DO NOT EXCEED MAP LIMITS DURING TAKEOFF.

24, 176B

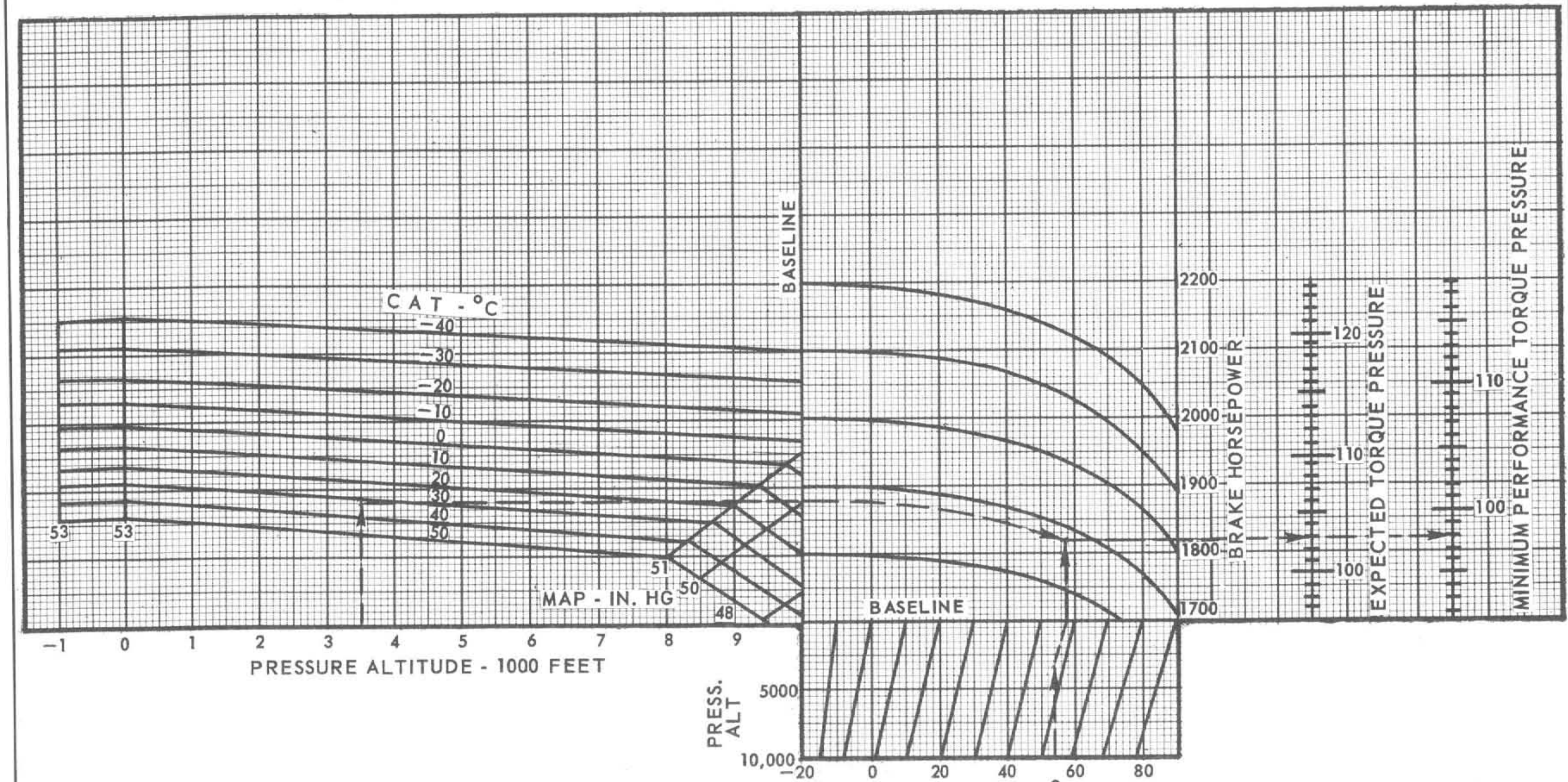
Figure A2-3

MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: ENGINE MANUFACTURER'S DATA

MAXIMUM DRY POWER AVAILABLE

LOW BLOWER 2800 RPM AUTO RICH
FUEL GRADE: 100/130

ENGINES: R2800-99W



NOTES:

(1) CAT EQUALS OAT +1° C.

(2) WHEN USING CABIN PRESSURIZATION, TORQUE PRESSURE FOR RIGHT ENGINE WILL BE 4.0 PSI LOWER.

(3) CHART BASED ON ZERO AIRSPEED. DO NOT EXCEED MAP LIMITS DURING TAKEOFF.

24, 177B

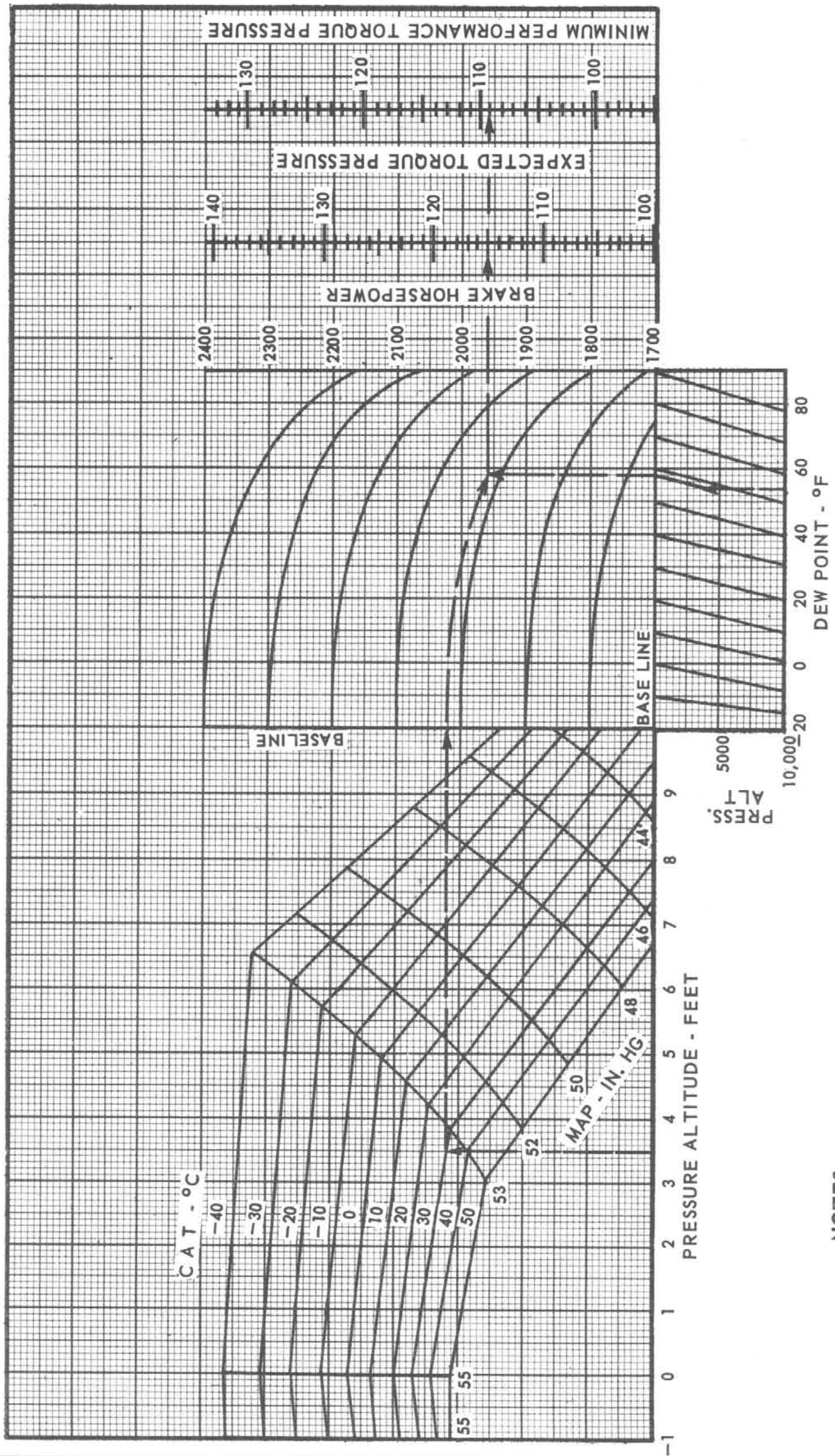
Figure A2-4

MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: **FLIGHT TEST**

ALTERNATE MAXIMUM DRY POWER AVAILABLE

LOW BLOWER 2700 RPM AUTO RICH
FUEL GRADE: 100/130

ENGINES: R2800-99W



NOTES:

(1) C A T EQUALS O A T + 1°C.
(2) WHEN USING CABIN PRESSURIZATION, TORQUE PRESSURE FOR RIGHT ENGINE WILL BE 4.0 PSI LOWER.
(3) CHART BASED ON ZERO AIRSPEED. DO NOT EXCEED MAP LIMITS DURING TAKEOFF.

24,178A

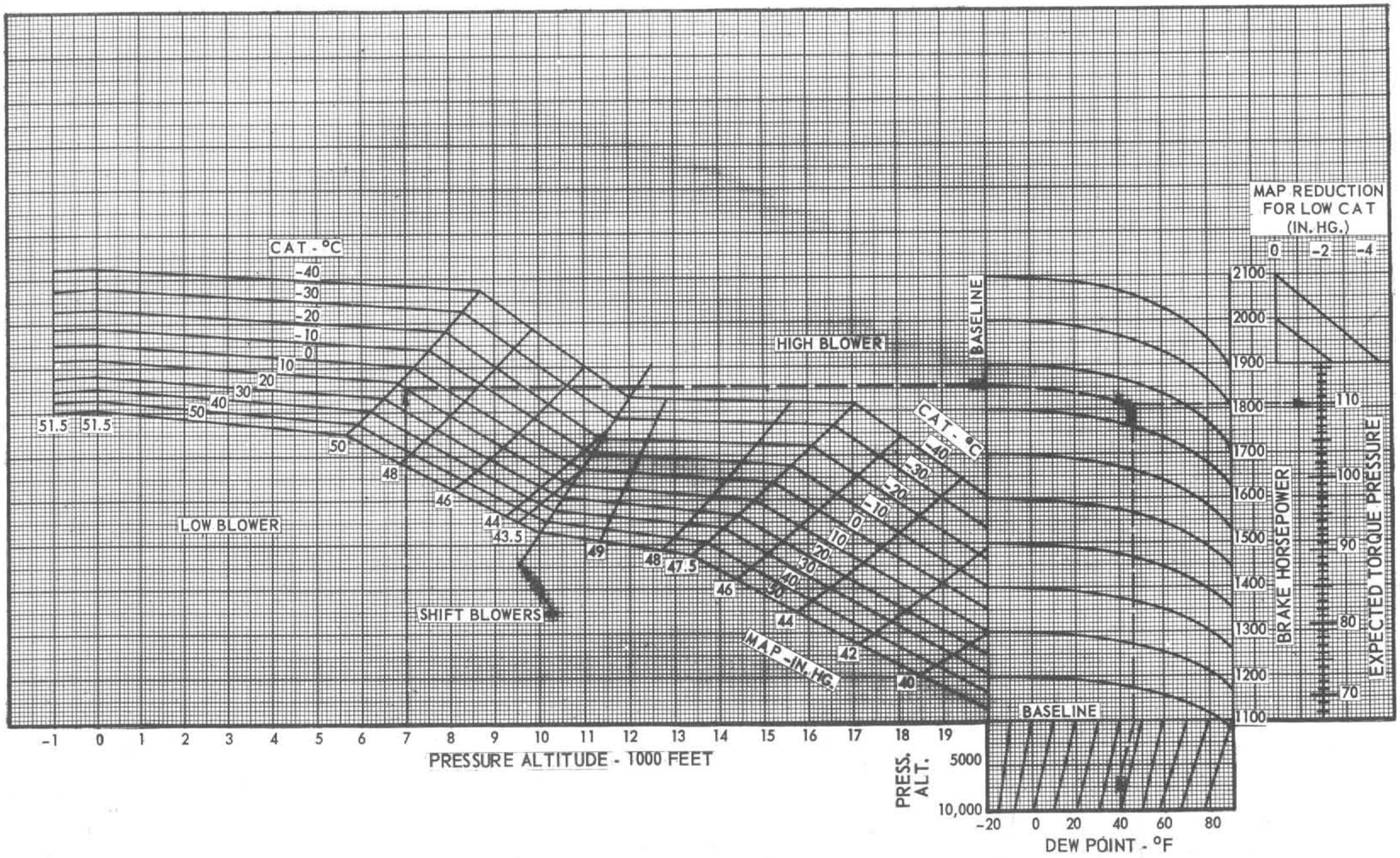
Figure A2-5

MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: ENGINE MANUFACTURER'S DATA

METO POWER AVAILABLE

FUEL GRADE 115/145
2600 RPM AUTO RICH

ENGINES: R2800-99W



NOTES:

(1) CAT EQUALS OAT + 1° C.

(2) WHEN USING CABIN PRESSURIZATION, TORQUE PRESSURE FOR RIGHT ENGINE WILL BE 3.8 PSI LOWER.

(3) WHEN DEW POINT IS UNKNOWN IN FLIGHT, READ STRAIGHT THROUGH DEW POINT CORRECTION GRAPH.

45,436

Figure A2-5A

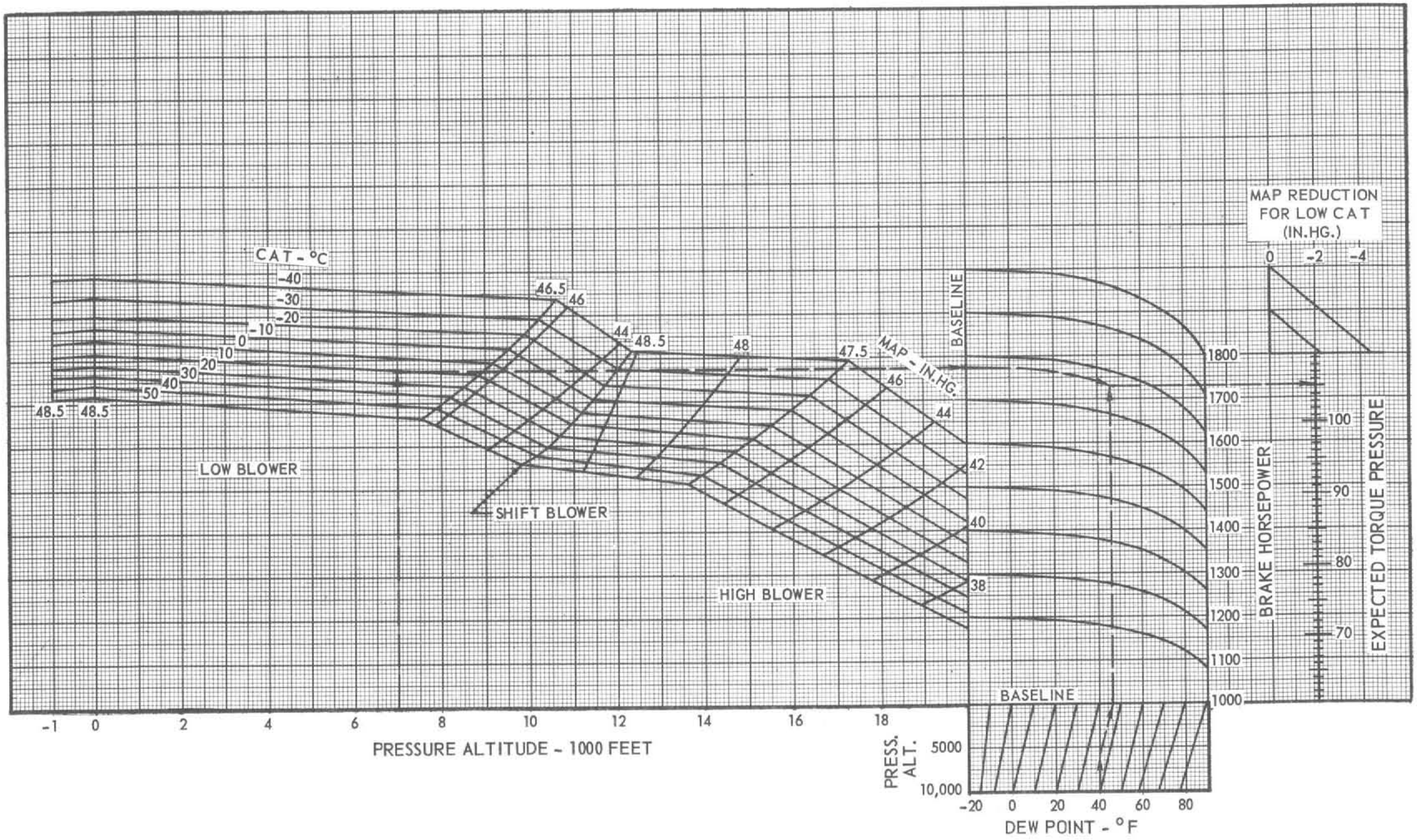
MODEL: C-131A
DATE: 14 JULY 1961
DATA BASIS: ENGINE MANUFACTURER'S DATA

METO POWER AVAILABLE

FUEL GRADE 100/130

2600 RPM AUTO-RICH

ENGINES: R2800-99W



NOTES:

(1) CAT EQUALS OAT + 1°C.

(2) WHEN USING CABIN PRESSURIZATION, TORQUE PRESSURE FOR THE RIGHT ENGINE WILL BE 3.8 PSI LOWER.

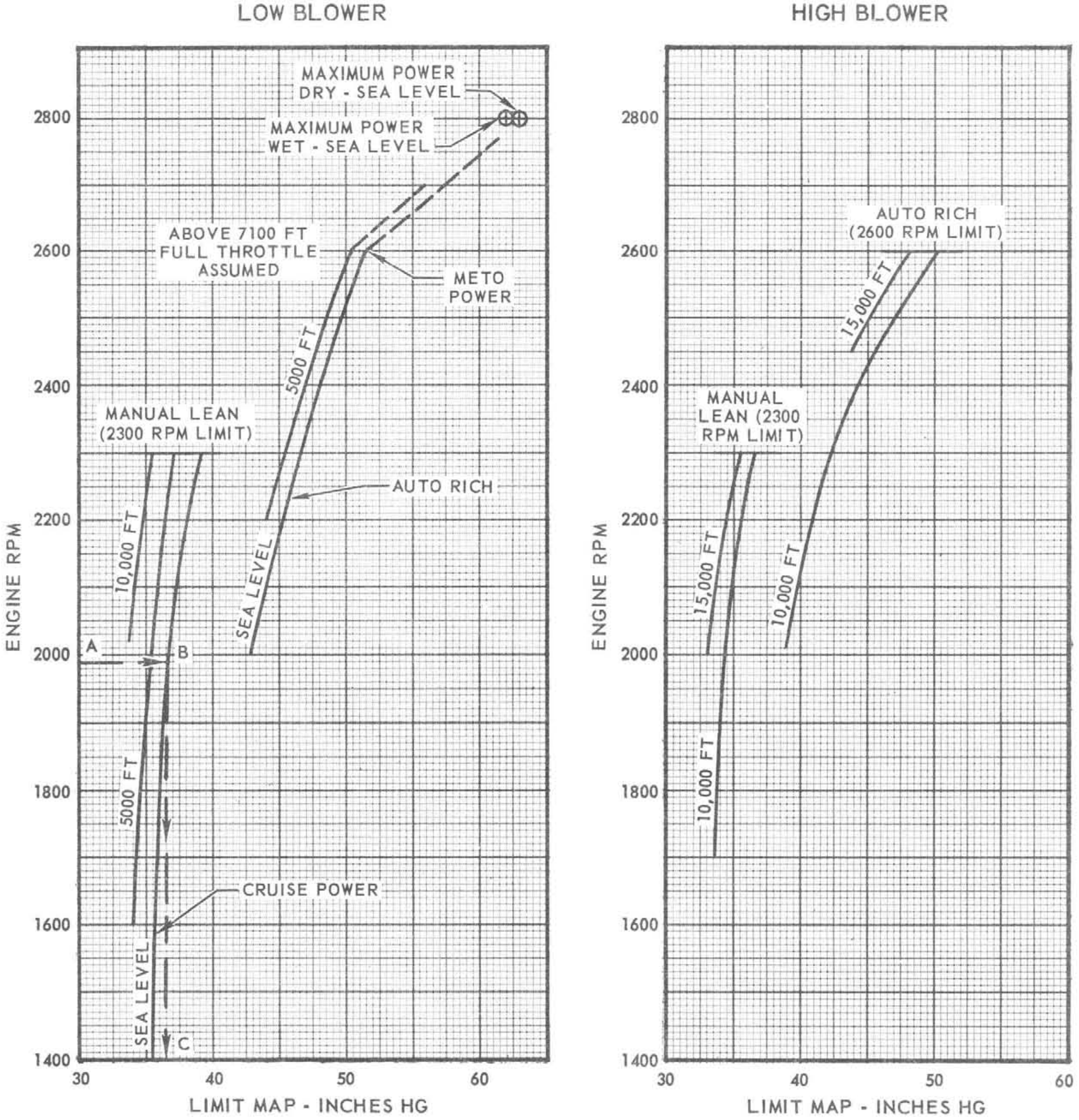
(3) WHEN DEW POINT IS UNKNOWN IN FLIGHT, READ STRAIGHT THROUGH DEW POINT CORRECTION GRAPH.

45,452

Figure A2-5B

MANIFOLD PRESSURE LIMITS

MODEL: C-131A
DATE: 15 MARCH 1955
FUEL GRADE: 115/145
STANDARD ATMOSPHERE
DATA BASIS: ENGINE MANUFACTURER'S DATA
ENGINES: R 2800 - 99W



LOW BLOWER

HIGH BLOWER

NOTES:

(1) IN MANUAL LEAN ADD 1/2 INCH MAP FOR EACH 10°C ABOVE STANDARD TEMPERATURE AND SUBTRACT 1/2 INCH MAP FOR EACH 10°C BELOW STANDARD, EXCEPT DO NOT EXCEED MAXIMUM MAP LIMIT.

(2) IN AUTO RICH, ADD 1 INCH MAP FOR EACH 10°C ABOVE STANDARD TEMPERATURE AND SUBTRACT 1 INCH MAP FOR EACH 10°C BELOW STANDARD EXCEPT DO NOT EXCEED MAXIMUM POWER AND METO POWER MAP LIMITS

45,389

Figure A2-6

CLIMB POWER SCHEDULE

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

2400 RPM - 1400 BHP

ENGINES: R 2800-99W

AUTO RICH MIXTURE

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE							BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30° C	−20° C	−10° C	0° C	+10° C	+20° C	+30° C					
22,000	F.T.							HIGH	2400	92	960	1110
21,000	36.7	F.T.										
20,000	36.7	37.4	F.T.									
19,000	36.8	37.5	38.2	F.T.	F.T.	SEE NOTE (3)						
18,000	36.8	37.5	38.2	38.8	39.6							
17,000	36.8	37.5	38.2	38.8	39.6							
16,000	36.8	37.5	38.2	38.8	39.6							
15,000	33.8	37.5	38.2	38.9	39.7							
14,000	33.9	34.5	38.2	38.9	39.7							
13,000	34.0	34.6	35.3	38.9	39.7							
12,000	34.1	34.7	35.4	36.1	39.7							
11,000	34.2	34.9	35.6	36.2	36.9							
10,000	34.3	35.0	35.7	36.3	37.0	37.6	38.3	LOW	2400	92	920	1065
9,000	34.5	35.1	35.8	36.5	37.1	37.8	38.4					
8,000	34.6	35.2	35.9	36.6	37.2	37.9	38.5					
7,000	34.7	35.3	36.0	36.7	37.4	38.1	38.6					
6,000	34.8	35.4	36.1	36.8	37.5	38.2	38.7					
5,000	35.0	35.7	36.4	37.1	37.8	38.5	39.0					
4,000	35.2	35.9	36.6	37.4	38.0	38.7	39.3					
3,000	35.4	36.1	36.8	37.5	38.2	38.9	39.5					
2,000	35.5	36.2	37.0	37.6	38.3	39.0	39.7					
1,000	35.8	36.5	37.3	37.9	38.6	39.3	40.0					
S.L.	36.1	36.8	37.5	38.2	38.9	39.6	40.2					

NOTES:

(1) F.T. INDICATES FULL THROTTLE.

(2) NO CABIN PRESSURIZATION LOAD.

(3) IF CARBURETOR AIR TEMPERATURE EXCEEDS 15°C, CONTINUE CLIMB IN LOW BLOWER

24,216C

Figure A2-7

CLIMB POWER SCHEDULE

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

METO POWER 2600 RPM
AUTO RICH MIXTURE

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE (°C)								BLOWER	BHP	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
20,000	40.7												
19,000	40.8	41.6											
18,000	43.5	44.4	42.5	43.3									
17,000	43.5	44.4	45.3	43.3									
16,000	43.5	44.4	45.3	46.2	44.2	44.9			HIGH	1500	91	1170	1235
15,000	43.7	44.6	45.4	46.3	47.1	45.0							
14,000	43.8	44.7	45.6	46.4	47.3	48.1			HIGH	1600	97	1260	1320
13,000	41.3	44.8	45.7	46.5	47.4	48.3							
12,000	41.3	42.2	45.8	46.7	47.5	48.4							
11,000	43.9	42.2	43.0	46.8	47.6	48.5							
10,000	46.9	44.8	43.1	43.9	47.8	48.6							
9,000	47.0	47.9	45.7	44.0	44.7	45.5							
8,000	47.0	48.0	48.9	46.6	47.5	45.6	46.4						
7,000	47.0	48.0	48.9	49.8	47.5	48.4	46.5	47.2	LOW	1700	103	1230	1290
6,000	47.0	48.0	48.9	49.9	47.6	48.4	49.2	47.3					
5,000	47.1	48.0	49.0	49.9	47.7	48.5	49.3	50.1	LOW	1800	109	1370	1390
4,000	47.1	48.1	49.0	49.9	47.8	48.6	49.4	50.2					
3,000	47.1	48.1	49.0	50.0	50.9	48.7	49.5	50.3					
2,000	47.2	48.1	49.1	50.0	50.9	48.8	49.6	50.5					
1,000	47.2	48.2	49.1	50.0	51.0	48.9	49.7	50.6					
S L	47.2	48.2	49.1	50.1	51.0	51.9			LOW	1900	115	1460	1490

NOTES:

(1) NO CABIN PRESSURIZATION LOAD

(2) MAXIMUM MAP IN LOW BLOWER (15°C A T) IS 51.5 IN.HG (S.L.) BHP WILL BE LESS THAN THAT SHOWN WHEN C A T IS HIGHER THAN 15° C (S.L.)

(3) MAXIMUM C A T IN HIGH BLOWER IS 15° C.

24,217E

Figure A2-8

POWER SCHEDULE

500 BHP/ENG

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
20,000	18.9	19.3	19.0	19.3	19.7	19.4	19.7	20.1	LOW	1900	41	265
19,000	19.7	19.4	19.8	20.2	19.8	20.2	20.5	20.3				
18,000	19.8	20.2	20.0	20.4	20.7	20.4	20.7	21.1	LOW	1800	44	255
17,000	20.6	20.4	20.8	21.2	20.9	21.3	21.6	21.3				
16,000	20.8	21.3	21.0	21.4	21.8	21.5	21.8	22.2	LOW	1700	46	250
15,000	21.0	21.5	21.9	22.4	22.0	22.4	22.8	22.4				
14,000	22.2	21.7	22.1	22.6	23.0	22.6	23.0	23.4	LOW	1600	49	240
13,000	22.4	22.9	23.4	22.8	23.2	23.6	24.0	23.6				
12,000	22.7	23.1	23.6	24.1	23.4	23.8	24.2	24.7	LOW	1500	53	235
11,000	22.9	23.4	23.8	24.3	24.7	25.1	24.4	24.9				
10,000	23.1	23.6	24.1	24.5	25.0	25.4	25.9	25.1				
9,000	23.4	23.9	24.4	24.8	25.3	25.7	26.2	26.6	LOW	1400	56	230
8,000	23.7	24.2	24.6	25.1	25.6	26.0	26.4	26.9				
7,000	24.0	24.5	24.9	25.4	25.9	26.3	26.7	27.2				
6,000	24.2	24.7	25.2	25.7	26.2	26.6	27.0	27.5				
5,000	24.5	25.0	25.5	26.0	26.5	27.0	27.4	27.9				
4,000	24.8	25.3	25.8	26.3	26.8	27.3	27.7	28.2				
3,000	25.2	25.7	26.2	26.7	27.2	27.7	28.2	28.7				
2,000	25.5	26.0	26.5	27.0	27.5	28.0	28.5	28.9				
1,000	25.9	26.4	26.9	27.4	27.9	28.4	28.9	29.3				
S.L.	26.2	26.7	27.2	27.7	28.2	28.7	29.2	29.7				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) NO CABIN PRESSURIZATION LOAD.

24,203C

Figure A2-9

POWER SCHEDULE

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

600 BHP/ENG

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10° C	0° C	+10° C	+20° C	+30° C	+38° C				
15,000	22.6	23.1	22.9	23.4	23.8	24.2			LOW	1700	56	280
14,000	22.9	23.3	23.7	24.2	24.1	24.5	24.9					
13,000	23.8	23.6	24.1	24.5	25.0	25.4	25.1	25.4				
12,000	24.0	24.5	25.0	24.8	25.3	25.7	26.1	25.6				
11,000	24.8	24.7	25.2	25.7	26.1	25.9	26.3	26.8	LOW	1600	59	270
10,000	25.1	25.7	25.4	25.8	26.3	26.7	26.5	27.0				
9,000	25.4	25.9	26.5	26.9	26.5	27.0	27.5	27.3				
8,000	25.7	26.3	26.8	27.2	27.7	27.2	27.7	28.1	LOW	1500	63	265
7,000	26.0	26.5	27.0	27.5	28.0	28.6	27.9	28.3				
6,000	26.4	26.9	27.4	27.9	28.5	29.0	29.4	28.5				
5,000	26.7	27.2	27.7	28.2	28.7	29.3	29.8	30.2	LOW	1400	68	260
4,000	27.0	27.5	28.1	28.7	29.1	29.7	30.2	30.6				
3,000	27.3	27.8	28.4	29.0	29.5	30.0	30.5	31.0				
2,000	27.6	28.1	28.7	29.2	29.7	30.3	30.8	31.3				
1,000	27.9	28.4	29.0	29.5	30.1	30.6	31.1	31.6				
S.L.	28.3	28.9	29.4	30.0	30.5	31.1	31.6	32.0				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) NO CABIN PRESSURIZATION LOAD.

24,204C

Figure A2-10

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

700 BHP/ENG

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
25,000	21.9	22.4	22.8	23.3	23.1	23.5	23.9		HIGH	2200	50	370
24,000	22.9	23.3	22.8	23.2	23.7	23.6	24.0					
23,000	22.9	23.3	23.8	23.3	23.7	24.1	24.0					
22,000	23.0	23.4	23.9	24.3	24.8	24.2	24.6		HIGH	2100	53	360
21,000	23.8	24.3	24.7	24.4	24.8	25.3	24.6					
20,000	23.9	24.4	24.8	24.5	24.9	25.4	25.8		HIGH	2000	55	350
19,000	24.8	25.3	24.9	25.4	25.9	26.3	25.8					
18,000	24.9	25.4	26.0	25.5	26.0	26.4	25.9					
17,000	23.2	25.5	26.1	26.5	27.0	26.5	27.0		HIGH	1900	58	340
16,000	23.5	23.9	26.2	26.7	27.1	27.6	27.1					
15,000	23.7	24.1	24.5	25.0	27.3	27.7	28.2		HIGH	1800	62	330
14,000	24.6	25.0	24.7	25.1	25.6	26.0	28.3					
13,000	24.8	25.3	25.8	26.3	25.9	26.3	26.8					
12,000	25.6	26.1	26.5	26.5	27.0	26.7	27.2	27.5	LOW	1800	62	320
11,000	25.8	26.3	26.9	27.4	27.2	27.7	28.2	27.8				
10,000	26.8	26.6	27.1	27.6	28.2	28.0	28.5	28.9	LOW	1700	66	315
9,000	27.1	27.6	27.3	27.8	28.4	28.8	28.7	29.1				
8,000	27.3	27.9	28.4	28.9	28.6	29.0	29.5	29.4				
7,000	28.4	28.9	28.7	29.3	29.8	30.3	29.7	30.1	LOW	1600	69	310
6,000	28.6	29.2	29.8	30.3	30.0	30.5	31.0	30.3				
5,000	29.0	29.6	30.2	30.7	31.3	30.8	31.3	31.7	LOW	1500	74	305
4,000	29.3	29.9	30.5	31.1	31.7	32.2	31.7	32.1				
3,000	29.7	30.3	30.9	31.5	32.1	32.7	33.3	33.7	LOW	1400	79	295
2,000	30.0	30.7	31.3	31.9	32.4	33.0	33.6	34.0				
1,000	30.4	31.0	31.7	32.3	32.8	33.4	34.0	34.4				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) NO CABIN PRESSURIZATION LOAD

24,205C

Figure A2-11

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

800 BHP/ENG

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN.HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
25,000	23.9	24.4	24.9	25.2	25.6	26.1	F.T.		HIGH	2300	55	405
24,000	23.9	24.5	24.9	25.5	25.8	26.2	26.7					
23,000	24.6	25.1	25.6	25.5	25.8	26.3	26.7					
22,000	22.6	23.1	25.7	26.2	25.9	26.3	26.8		HIGH	2200	58	392
21,000	23.2	23.3	23.7	26.4	26.8	27.3	26.8					
20,000	23.3	23.6	23.8	24.3	24.7	27.4	27.9		HIGH	2100	61	384
19,000	23.9	23.7	24.1	24.6	24.9	25.3	27.9					
18,000	24.0	24.4	24.3	24.8	25.2	25.5	26.0					
17,000	24.7	24.5	25.0	25.5	25.3	25.8	26.2	26.5	LOW	2200	58	392
16,000	24.8	25.3	25.2	25.6	26.1	26.0	26.5	26.9	LOW	2100	61	382
15,000	25.0	25.5	26.0	26.5	26.3	26.7	26.7	27.1				
14,000	26.1	25.6	26.1	26.7	27.1	26.9	27.4	27.8	LOW	2000	64	373
13,000	26.3	26.8	27.3	26.9	27.4	27.8	27.5	27.9				
12,000	27.2	27.0	27.5	28.0	28.6	28.0	28.5	28.9	LOW	1900	67	366
11,000	27.4	28.0	28.5	28.2	28.8	29.2	28.7	29.1				
10,000	28.1	28.2	28.7	29.2	29.0	29.5	30.0	30.4	LOW	1800	72	357
9,000	28.3	28.8	29.4	29.4	30.0	30.5	30.2	30.6				
8,000	28.7	29.2	29.8	30.3	30.2	30.7	31.2	30.8				
7,000	29.6	30.2	30.1	30.6	31.2	30.9	31.5	31.9	LOW	1700	74	350
6,000	29.9	30.5	31.1	31.0	31.5	32.0	32.6	32.1				
5,000	30.1	30.7	31.3	31.9	31.7	32.2	32.8	33.2	LOW	1600	79	345
4,000	30.4	31.0	31.6	32.2	32.8	33.4	32.9	33.3				
3,000	30.7	31.2	31.9	32.5	33.1	33.7	34.3	34.7	LOW	1500	85	340
2,000	31.0	31.6	32.3	32.9	33.5	34.0	34.6	35.0				
1,000	31.4	32.0	32.7	33.3	33.9	34.4	35.0	35.4				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.
(2) F.T. INDICATES FULL THROTTLE.
(3) NO CABIN PRESSURIZATION LOAD.

24,206C

Figure A2-12

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

900 BHP/ENG

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
25,000	26.7	27.2	F.T.	F.T.					HIGH	2300	62	452
24,000	26.6	27.2	27.7	28.2	F.T.	F.T.						
23,000	26.7	27.3	27.8	28.2	28.8	29.3	F.T.					
22,000	26.7	27.3	27.8	28.3	28.8	29.2	29.7					
21,000	27.2	27.8	27.9	28.4	28.9	29.3	29.7					
20,000	25.0	27.8	28.3	28.9	28.9	29.4	29.9					
19,000	25.0	25.5	26.1	28.8	29.4	29.9	29.9		HIGH	2200	65	440
18,000	25.5	26.0	26.2	26.7	27.1	30.0	30.5					
17,000	25.6	26.1	26.7	27.2	27.2	27.7	30.6		HIGH	2100	68	430
16,000	26.3	26.8	26.8	27.3	27.7	27.8	28.3					
15,000	26.4	26.9	27.5	27.4	27.9	28.3	28.5	28.9	LOW	2200	65	426
14,000	27.3	27.8	27.6	28.2	28.7	28.5	29.0	29.0				
13,000	27.4	28.0	28.5	28.3	28.8	29.3	29.2	29.6	LOW	2100	68	418
12,000	28.5	28.2	28.7	29.3	28.9	29.5	30.0	29.7				
11,000	28.7	29.3	29.8	29.6	30.1	29.7	30.2	30.6	LOW	2000	72	409
10,000	28.9	29.5	30.0	30.6	30.2	30.7	30.3	30.7				
9,000	29.9	30.5	31.1	30.7	31.3	30.9	31.5	31.9	LOW	1900	75	403
8,000	30.4	31.1	31.3	31.8	31.5	32.0	31.6	32.0				
7,000	30.6	31.2	31.9	32.1	32.7	32.3	32.9	33.3	LOW	1800	80	396
6,000	31.0	31.6	32.2	32.9	32.9	33.5	34.1	33.5				
5,000	31.1	31.8	32.4	33.0	33.6	34.2	34.3	34.7	LOW	1700	84	389
4,000	31.3	31.9	32.5	33.2	33.8	34.4	35.0	35.4	LOW	1650	86	385
3,000	31.5	32.1	32.7	33.4	34.0	34.6	35.2	35.6				
2,000	31.7	32.4	33.0	33.7	34.2	34.8	35.4	35.8				
1,000	32.0	32.6	33.3	33.9	34.5	35.1	35.7	36.1				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) F.T. INDICATES FULL THROTTLE.

(3) NO CABIN PRESSURIZATION LOAD.

24,207D

Figure A2-13

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

950 BHP/ENG

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
25,000	28.0	28.5	F.T.						HIGH	2300	66	470
24,000	28.0	28.5	29.0	F.T.								
23,000	28.1	28.6	29.1	29.4	F.T.	F.T.						
22,000	28.0	28.6	29.1	29.7	30.2	30.7						
21,000	28.3	28.9	29.2	29.8	30.2	30.7						
20,000	26.0	29.0	29.5	30.1	30.3	30.8			HIGH	2200	70	460
19,000	26.1	26.6	27.2	30.2	30.6	30.8						
18,000	26.5	27.0	27.3	27.8	30.6	31.1			HIGH	2100	72	450
17,000	26.6	27.1	27.7	27.9	28.3	31.2						
16,000	27.3	27.8	27.9	28.4	28.5	29.0			LOW	2200	70	445
15,000	27.5	28.0	28.6	28.5	29.0	29.1	29.3	29.8				
14,000	28.0	28.6	28.7	29.3	29.3	29.7	29.7	30.0				
13,000	28.2	28.8	29.3	29.5	30.1	29.8	30.3	30.8	LOW	2100	72	436
12,000	29.1	29.7	29.5	30.1	30.2	30.8	30.5	31.0				
11,000	29.3	29.9	30.4	30.2	30.2	31.0	31.5	32.0	LOW	2000	76	430
10,000	30.2	30.0	30.6	31.2	31.0	31.6	31.7	32.2				
9,000	30.4	31.0	30.8	31.3	32.0	31.8	32.3	32.8	LOW	1950	78	425
8,000	30.7	31.3	32.0	31.5	32.1	32.7	32.5	33.0				
7,000	30.9	31.5	32.2	32.7	33.3	32.9	33.4	33.9	LOW	1850	81	420
6,000	31.2	31.8	32.4	33.0	33.6	34.2	33.6	34.1				
5,000	31.3	31.9	32.6	33.2	33.8	34.4	35.0	35.5	LOW	1750	86	410
4,000	31.4	32.0	32.7	33.3	33.9	34.5	35.1	35.6				
3,000	31.6	32.2	32.9	33.5	34.1	34.7	35.3	35.8				
2,000	31.8	32.5	33.1	33.7	34.3	34.9	35.5	35.9				
1,000	32.0	32.6	33.3	33.9	34.5	35.1	35.7	36.1				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.
(2) F.T. INDICATES FULL THROTTLE.
(3) NO CABIN PRESSURIZATION LOAD.

24,150A

Figure A2-14

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1000 BHP/ENG

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	–30°C	–20°C	–10°C	0°C	+10°C	+20°C	+30°C	+38°C				
23,000	29.1	29.7	F.T.	F.T.					HIGH	2300	69	491
22,000	29.1	29.7	30.3	30.9	F.T.							
21,000	29.2	29.7	30.3	30.9	31.4	F.T.						
20,000	29.5	29.8	30.3	30.9	31.4	32.0	F.T.					
19,000	29.6	30.2	30.7	30.9	31.4	32.0	32.6					
18,000	27.0	27.5	30.8	31.3	31.5	32.0	32.6					
17,000	27.2	27.7	28.3	31.4	31.8	32.0	32.6		HIGH	2200	72	480
16,000	27.8	28.3	28.4	28.9	31.9	32.4	32.6					
15,000	27.9	28.5	29.1	29.0	29.6	32.5	33.0		HIGH	2100	76	468
14,000	28.8	29.4	29.2	29.7	29.7	30.1	33.0					
13,000	28.9	29.5	30.1	29.8	30.4	30.2	30.8	31.2	LOW	2200	72	463
12,000	29.8	30.3	30.2	30.7	30.5	31.1	31.7	31.4				
11,000	30.4	30.6	31.2	30.9	31.4	31.3	31.9	32.3	LOW	2100	76	455
10,000	30.5	31.1	31.3	31.9	31.5	32.1	32.7	32.4				
9,000	30.7	31.3	32.0	32.1	32.6	32.2	32.8	33.2	LOW	2000	79	450
8,000	30.9	31.5	32.1	32.6	32.8	33.4	34.0	33.4				
7,000	31.1	31.7	32.3	32.9	33.5	34.2	34.2	34.6	LOW	1900	83	445
6,000	31.3	31.9	32.5	33.1	33.7	34.3	34.9	35.3	LOW	1850	86	440
5,000	31.4	32.1	32.7	33.3	33.9	34.5	35.1	35.5				
4,000	31.6	32.3	32.9	33.6	34.2	34.8	35.4	35.8				
3,000	31.9	32.5	33.1	33.8	34.3	35.0	35.6	36.0				
2,000	32.0	32.7	33.3	33.9	34.5	35.1	35.7	36.1				
1,000	32.3	32.9	33.6	34.2	34.8	35.4	36.0	36.4				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) F.T. INDICATES FULL THROTTLE

(3) NO CABIN PRESSURIZATION LOAD.

24,208D

Figure A2-15

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1050 BHP/ENG

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
23,000	30.6	F.T.	F.T.						HIGH	2300	72	515
22,000	30.4	31.0	31.6	F.T.								
21,000	30.3	30.9	31.7	32.2	F.T.	F.T.						
20,000	30.4	31.0	31.5	32.2	32.8	33.3						
19,000	30.7	31.3	31.6	32.2	32.9	33.4						
18,000	28.2	31.5	31.9	32.3	32.7	33.3			HIGH	2200	76	500
17,000	28.3	28.9	32.1	32.6	32.8	33.4						
16,000	28.8	29.0	29.6	32.7	33.2	33.9			HIGH	2100	80	490
15,000	28.9	29.5	29.7	30.2	33.3	34.0						
14,000	29.8	29.7	30.3	30.3	30.9	31.4			LOW	2200	76	485
13,000	29.9	30.5	30.5	31.0	31.0	31.5						
12,000	30.4	30.7	31.2	31.1	31.7	32.3	32.3	32.7				
11,000	30.6	31.2	31.3	32.0	32.0	32.5	32.5	32.9				
10,000	30.7	31.3	31.9	32.1	32.8	33.2	33.1	33.6	LOW	2100	80	475
9,000	30.8	31.5	32.1	32.7	33.3	33.8	33.8	33.8				
8,000	31.0	31.6	32.3	32.8	33.5	34.0	34.0	34.5	LOW	2000	83	470
7,000	31.2	31.8	32.4	33.0	33.7	34.2	34.8	34.6				
6,000	31.3	32.0	32.6	33.2	33.8	34.4	35.0	35.4	LOW	1950	86	465
5,000	31.5	32.1	32.8	33.4	34.0	34.6	35.2	35.6				
4,000	31.7	32.3	32.9	33.6	34.2	34.8	35.4	35.8				
3,000	31.9	32.5	33.2	33.8	34.4	35.0	35.6	36.0				
2,000	32.1	32.7	33.4	34.0	34.6	35.2	35.8	36.2				
1,000	32.3	32.9	33.6	34.2	34.8	35.4	36.0	36.4				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) F.T. INDICATES FULL THROTTLE.

(3) NO CABIN PRESSURIZATION LOAD.

24,151A

Figure A2-16

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1100 BHP/ENG

ENGINES: R2800-99W

MANUAL LEAN FROM BEST POWER

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C				
21,000	31.6	32.1	F.T.	F.T.					HIGH	2300	76	535
20,000	31.6	32.1	32.8	33.4	F.T.							
19,000	31.7	32.1	32.8	33.5	34.0	F.T.						
18,000	31.9	32.2	32.9	33.4	34.1	34.6	F.T.					
17,000	32.0	32.4	33.1	33.5	34.0	34.6	35.1					
16,000	29.3	29.9	33.2	33.7	34.1	34.6	35.1					
15,000	30.1	30.1	30.6	33.8	34.3	34.6	35.1		HIGH	2200	79	520
14,000	30.2	30.7	30.7	31.3	34.4	35.1	35.1					
13,000	31.0	30.9	31.5	31.4	32.0	35.2	35.7		HIGH	2100	83	510
12,000	31.1	31.7	31.7	32.2	32.2	32.8	35.7					
11,000	31.2	31.9	32.5	32.3	32.9	33.0	33.6	34.0	LOW	2200	79	505
10,000	31.3	32.0	32.6	33.2	33.0	33.6	34.2	34.1				
9,000	31.5	32.1	32.8	33.4	34.0	33.7	34.3	34.7	LOW	2100	83	495
8,000	31.7	32.3	33.0	33.5	34.2	34.8	35.4	34.9				
7,000	31.9	32.5	33.1	33.7	34.3	35.0	35.6	36.0	LOW	2000	87	490
6,000	32.1	32.7	33.4	34.0	34.6	35.2	35.8	36.2				
5,000	32.2	32.8	33.5	34.1	34.7	35.3	35.9	36.3				
4,000	32.3	33.0	33.7	34.3	34.9	35.5	36.1	36.5				
3,000	32.6	33.3	34.0	34.6	35.2	35.8	36.4	36.8				
2,000	32.7	33.4	34.1	34.7	35.3	35.9	36.5	37.0				
1,000	32.8	33.5	34.2	34.8	35.4	36.0	36.7	37.2				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) F.T. INDICATES FULL THROTTLE.

(3) NO CABIN PRESSURIZATION LOAD.

24,209D

Figure A2-17

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1150 BHP/ENG

ENGINE: R2800-99W

PRESSURE ALTITUDE (FT)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	NOMINAL FUEL FLOW (PPH)
	− 30° C	− 20° C	− 10° C	0° C	+ 10° C	+ 20° C	+ 30° C	+ 38° C				
20,000	33.2	F.T.							HIGH	2300	80	533
19,000	33.2	33.8	F.T.									
18,000	33.0	33.6	34.4	F.T.								
17,000	33.0	33.6	34.3	35.1	F.T.							
16,000	33.0	33.6	34.3	34.9	35.6	F.T.						
15,000	32.9	33.6	34.2	34.8	35.5	36.2	F.T.					
14,000	30.7	31.4	32.0	34.8	35.5	36.2	36.7					
13,000	30.8	31.4	32.1	32.7	35.4	36.0	36.7		HIGH	2200	83	539
12,000	31.3	31.9	32.6	32.8	33.3	36.0	36.7					
11,000	31.6	32.2	32.8	33.4	33.5	34.1	34.6	35.0	LOW	2200	83	522
10,000	31.7	32.3	33.0	33.6	34.2	34.2	34.8	35.2				
9,000	31.8	32.4	33.1	33.7	34.3	34.9	35.5	35.3				
8,000	31.9	32.6	33.2	33.8	34.5	35.1	35.7	35.9	LOW	2100	87	513
7,000	32.0	32.7	33.3	33.9	34.6	35.2	35.8	36.0				
6,000	32.2	32.8	33.5	34.1	34.8	35.4	35.9	36.2				
5,000	32.4	33.0	33.7	34.3	34.9	35.5	36.2	36.5				
4,000	32.6	33.2	33.9	34.6	35.2	35.8	36.4	36.8				
3,000	32.8	33.4	34.1	34.8	35.4	36.0	36.6	37.0				
2,000	32.9	33.6	34.3	34.9	35.5	36.1	36.8	37.2				
1,000	33.2	33.9	34.6	35.2	35.8	36.4	37.1	37.5				

NOTES:

(1) MANUAL LEAN MIXTURE SETTING ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) F.T. INDICATES FULL THROTTLE.

(3) NO CABIN PRESSURIZATION LOAD.

24,152

Figure A2-18

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1200 BHP/ENG

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
19,000	34.1	F.T.							HIGH	2300	82.5	575	700
18,000	33.9	34.6	F.T.	F.T.									
17,000	33.9	34.6	35.3	36.0	F.T.								
16,000	31.3	34.5	35.2	35.8	36.5	F.T.	F.T.						
15,000	31.3	31.9	35.2	35.8	36.4	37.1	37.7						
14,000	31.7	32.1	32.7	33.3	36.4	37.0	37.6						
13,000	31.8	32.4	32.8	33.4	34.0	37.0	37.6						
12,000	31.9	32.5	33.1	33.7	34.0	34.6	37.6						
11,000	32.0	32.7	33.3	34.0	34.6	34.8	35.4	35.8	LOW	2300	82	555	
10,000	32.2	32.8	33.5	34.1	34.7	35.3	35.4	35.8					
9,000	32.3	33.0	33.7	34.3	34.9	35.5	36.1	36.5	LOW	2200	87	542	
8,000	32.6	33.2	33.8	34.4	35.1	35.7	36.3	36.7					
7,000	32.7	33.3	34.0	34.6	35.2	35.9	36.5	37.0					
6,000	32.8	33.5	34.2	34.8	35.5	36.1	36.6	37.1					
5,000	33.0	33.7	34.4	35.0	35.6	36.3	36.9	37.3					
4,000	33.2	33.9	34.6	35.3	35.9	36.5	37.1	37.6					
3,000	33.4	34.0	34.7	35.4	36.0	36.6	37.2	37.7					
2,000	33.6	34.3	35.0	35.6	36.2	36.8	37.5	38.0					
1,000	33.8	34.5	35.2	35.8	36.4	37.0	37.7	38.2					

NOTES:

(1) MANUAL LEAN MIXTURE SETTING IN LOW BLOWER ESTABLISHED BY 7 PSI TORQUE PRESSURE DROP FROM BEST POWER.

(2) MANUAL ADJUST TO DESIRED FUEL FLOW IN HIGH BLOWER.

(3) F.T. INDICATES FULL THROTTLE.

(4) NO CABIN PRESSURIZATION LOAD.

24,210D

Figure A2-19

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1300 BHP/ENG

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
14,000	F.T.												
13,000	33.3	33.9	34.6	F.T.									
12,000	33.4	34.1	34.7	35.4	F.T.								
11,000	33.5	34.2	34.9	35.5	36.2	F.T.			LOW	2300	89.5	690	776
10,000	33.6	34.3	35.0	35.6	36.3	36.9							
9,000	33.8	34.4	35.1	35.7	36.4	37.1							
8,000	33.9	34.5	35.2	35.8	36.5	37.2							
7,000	34.0	34.7	35.4	36.0	36.7	37.4							
6,000	34.2	34.8	35.5	36.2	36.9	37.5							
5,000	34.3	35.0	35.7	36.4	37.1	37.7							
4,000	34.4	35.2	35.9	36.6	37.3	37.9							
3,000	34.7	35.4	36.1	36.9	37.5	38.2							
2,000	34.9	35.7	36.4	37.1	37.7	38.4							
1,000	35.2	35.9	36.6	37.3	38.0	38.6							

NOTES:

(1) MINIMUM FUEL FLOWS ARE ENGINE MANUFACTURER'S DATA.

(2) DESIRED FUEL FLOWS ARE BASED ON FLIGHT TEST USING MANUAL ADJUST PROCEDURE.

(3) F.T. INDICATES FULL THROTTLE.

(4) NO CABIN PRESSURIZATION LOAD.

(5) MAXIMUM C A T 15°C IN HIGH BLOWER

24,211D

Figure A2-20

POWER SCHEDULE

1400 BHP/ENG

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
22,000	F.T.	F.T.							HIGH	2500	89	1000	1050
20,000	37.3	37.7	F.T.	F.T.	F.T.	F.T.							
18,000	36.7	37.5	38.2	39.4	40.2	40.8							
16,000	36.8	37.5	38.3	38.9	39.6	40.3							
14,000	34.2	37.6	38.3	39.0	39.8	40.3			HIGH	2400	92	920	970
12,000	34.5	35.2	35.9	39.1	39.9	40.6			HIGH	2300	96	870	925
10,000	34.7	35.4	36.1	36.7	37.4	40.8							
8,000	35.0	35.7	36.4	37.1	37.8	38.4	39.0		LOW	2300	96	850	870
6,000	35.3	36.0	36.7	37.4	38.1	38.7	39.3						
4,000	35.6	36.3	37.0	37.8	38.4	39.1	39.7						
2,000	36.0	36.7	37.4	38.1	38.8	39.5	40.2						
SEA LEVEL	36.3	37.0	37.7	38.4	39.2	39.8	40.5						

NOTES:

(1) MINIMUM FUEL FLOWS ARE ENGINE MANUFACTURER'S DATA.

(2) DESIRED FUEL FLOW VALUES ARE BASED ON FLIGHT TEST USING MANUAL ADJUST PROCEDURE.

(3) F.T. INDICATES FULL THROTTLE.

(4) NO CABIN PRESSURIZATION LOAD.

(5) MAXIMUM C A T 15°C IN HIGH BLOWER

24,212D

Figure A2-21

POWER SCHEDULE

1500 BHP/ENG

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
22,000	F.T.								HIGH	2500	95	1110	1145
20,000	40.2	F.T.	F.T.										
18,000	39.6	41.0	41.8	F.T.	F.T.								
16,000	39.7	40.4	41.2	42.8	43.5	F.T.							
14,000	36.3	40.5	41.4	42.1	42.8	43.5							
12,000	36.5	37.2	37.9	42.2	42.9	43.5			HIGH	2400	99	1040	1045
10,000	36.7	37.4	38.1	38.8	39.5	43.7							
8,000	36.9	37.7	38.4	39.0	39.8	40.5	41.2		LOW	2400	99	980	1030
6,000	37.3	38.0	38.7	39.5	40.2	40.9	41.6						
4,000	37.5	38.3	39.1	39.8	40.5	41.3	41.9						
2,000	37.9	38.7	39.5	40.2	40.9	41.6	42.7						
SEA LEVEL	38.4	39.2	39.9	40.6	41.4	42.1	42.7						

NOTES:

(1) MINIMUM FUEL FLOWS ARE ENGINE MANUFACTURER'S DATA.

(2) DESIRED FUEL FLOW VALUES ARE BASED ON FLIGHT TEST USING MANUAL ADJUST PROCEDURE.

(3) F.T. INDICATES FULL THROTTLE.

(4) NO CABIN PRESSURIZATION LOAD.

(5) MAXIMUM C A T 15°C IN HIGH BLOWER

24,213D

Figure A2-22

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1600 BHP/ENG

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
20,000	F.T.	F.T.	F.T.	F.T.	F.T.				HIGH	2600	98	1260	1320
18,000	43.7	44.4	45.3	46.2	47.1								
16,000	42.9	43.7	44.7	46.3	47.1								
14,000	42.9	43.8	44.7	45.5	46.4				HIGH	2500	101	1210	1230
12,000	38.7	39.5	40.3	45.4	46.2								
10,000	38.9	39.7	40.5	41.2	42.0								
8,000	39.2	40.0	40.8	41.5	42.3	43.0			LOW	2500	101	1110	1170
6,000	39.4	40.2	41.0	41.8	42.6	43.3							
4,000	39.7	40.5	41.4	42.2	42.9	43.7							
2,000	40.3	41.1	41.9	42.7	43.4	44.2							
SEA LEVEL	40.8	41.6	42.4	43.2	44.0	44.7							

NOTES:

(1) AUTO RICH MIXTURE

(2) FUEL FLOW MAY BE MANUALLY ADJUSTED TO MINIMUM FUEL FLOW VALUE IF REQUIRED BY EMERGENCY RANGE CONDITIONS.

(3) F.T. INDICATES FULL THROTTLE.

(4) NO CABIN PRESSURIZATION LOAD.

24,214E

Figure A2-23

MODEL: C-131A
DATE: 1 APRIL 1957
DATA BASIS: ENGINE MANUFACTURER'S DATA

POWER SCHEDULE

1700 BHP/ENG

ENGINES: R2800-99W

PRESSURE ALTITUDE (FEET)	MANIFOLD PRESSURE (IN. HG) CARBURETOR AIR TEMPERATURE								BLOWER	RPM	NOMINAL TORQUE PRESSURE (PSI)	MINIMUM FUEL FLOW (PPH)	DESIRED FUEL FLOW (PPH)
	−30°C	−20°C	−10°C	0°C	+10°C	+20°C	+30°C	+38°C					
20,000	F.T.	F.T.							HIGH	2600	104	1360	1390
18,000	46.2	47.0											
16,000	46.4	47.3	F.T.										
14,000	46.7	47.7	48.6										
12,000	41.3	42.2	42.9										
10,000	41.4	42.3	43.1	43.8	44.7								
8,000	41.7	42.5	43.4	44.2	44.9	45.7			LOW	2600	104	1250	1295
6,000	41.9	42.7	43.6	44.5	45.2	46.0			LOW	2500	108	1220	1270
4,000	42.1	42.9	43.8	44.7	45.4	46.2							
2,000	42.3	43.2	44.1	44.9	45.8	46.5							
SEA LEVEL	42.8	43.6	44.5	45.3	46.2	46.9							

NOTES:

(1) AUTO RICH MIXTURE

(2) FUEL FLOW MAY BE MANUALLY ADJUSTED TO MINIMUM FUEL FLOW VALUE IF REQUIRED BY EMERGENCY RANGE CONDITIONS.

(3) F.T. INDICATES FULL THROTTLE.

(4) NO CABIN PRESSURIZATION LOAD.

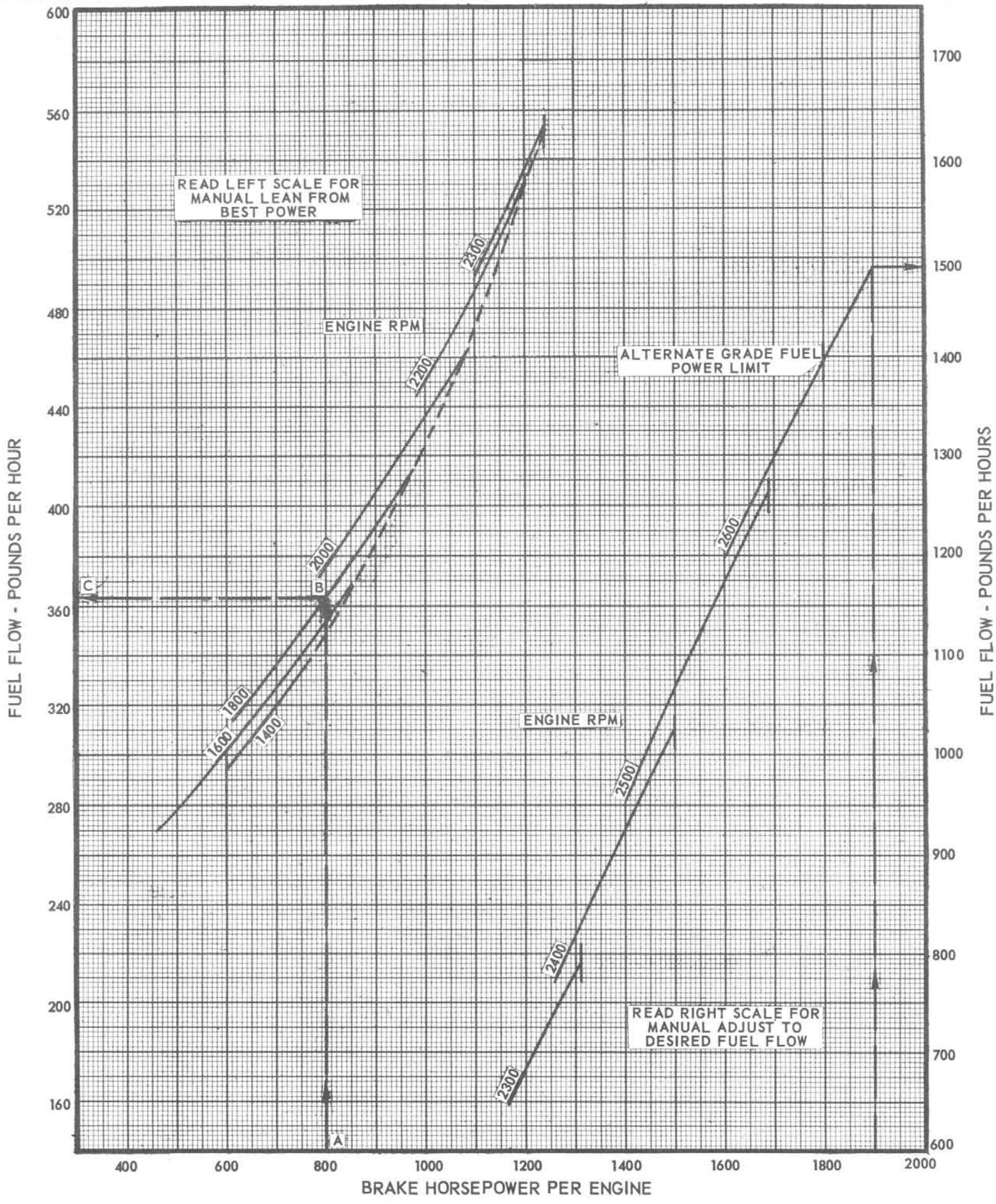
24,215E

Figure A2-24

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

FUEL FLOW PER ENGINE
LOW BLOWER

ENGINES: R2800-99W



24,218C

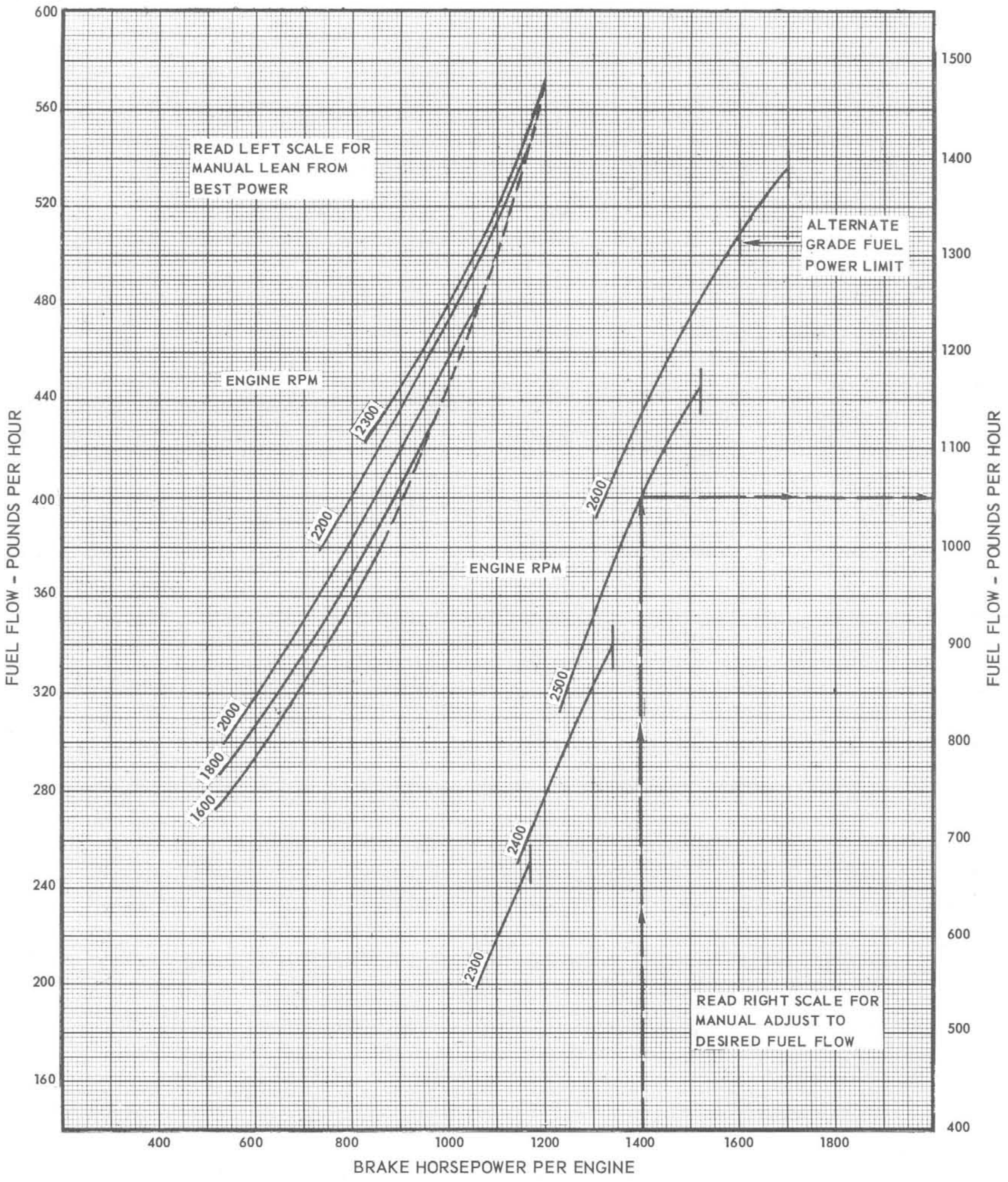
Figure A2-25

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

FUEL FLOW PER ENGINE

HIGH BLOWER

ENGINES: R-2800-99W



24,179A

Figure A2-26

PART 3—TAKEOFF

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*The symbol * indicates an illustration*

TAKEOFF

DEFINITION OF TERMS

1. CRITICAL FIELD LENGTH—The total length of runway required to accelerate on all engines to the critical engine failure speed, experience an engine failure, then continue to takeoff or to stop.
2. CRITICAL ENGINE FAILURE SPEED—The speed at which engine failure permits acceleration to takeoff on one engine in the same distance that the airplane may be decelerated to a stop.
3. REFUSAL SPEED AND DISTANCE—The refusal speed is the maximum speed to which the airplane can accelerate and then stop in the available runway

length. The refusal distance is the distance required to accelerate to the refusal speed under normal conditions.

4. GO-NO-GO SPEED AND DISTANCE—The go-no-go distance is the distance to the runway marker which is the first 1000-foot marker before the normal refusal distance (no wind). It is also the point at which a final decision to continue or abort the takeoff is made. The go-no-go speed is the minimum speed allowable at the go-no-go distance marker.
5. ACCELERATION CHECK SPEED AND DISTANCE—The acceleration check distance is the distance from the start of takeoff to an acceleration check point. (For the go-no-go concept, it is the distance to the runway marker which is 1000 feet less than the go-no-go distance marker.) Use of this acceleration check speed, however, is optional since this speed may not occur far enough down the runway to allow for a reliable check on airspeed (acceleration).
6. TAKEOFF SPEED AND DISTANCE—Takeoff speed is the speed at which the main gear leaves the ground. Takeoff distance is the ground run in feet to takeoff speed.
7. MINIMUM CONTROL SPEED—This speed is determined from flight tests with maximum power on one engine, and the critical engine propeller windmilling. Under these conditions, the minimum control speed is the minimum speed at which directional control can be maintained with rudder and aileron. Minimum control speed is affected by altitude and is independent of weight.

DISCUSSION OF TAKEOFF TERMS

The Relationship of Takeoff Terms (figure A3-1) illustrates the relationship of the terms used in the takeoff charts. The upper curve represents the sum of the distances required to accelerate on two engines to engine failure speed, and then to stop, using brakes only. The lower curve represents the sum of the distances required to accelerate on two engines to refusal speed (D) and then to continue to accelerate on one engine to takeoff speed (E). In operation, when runway length is greater than critical field length, and refusal speed is greater than takeoff speed, then takeoff speed becomes the criterion for aborting a takeoff. Many factors, such as runway surface, weather conditions, engine conditions, etc., may cause the airplane to deviate from the ideal performance, and result in loss of acceleration. Line speed checks will give an early indication of rate of acceleration. The go-no-go concept was adopted to make possible the use of the line speed markers instead of the refusal speed check. Point (C) on the diagram represents the go-no-go distance, and the speed the airplane should have attained at the go-no-go marker. This is the normal acceleration speed, which, when corrected for speed tolerance and wind, is the go-no-go speed of the airplane (B). Experience shows that stops made from the go-no-go point increase tire and brake wear unnecessarily, so that a policy of checking the rate of acceleration during takeoff ground run is desirable. Point (A) on the diagram represents the first acceleration speed check prior to go-no-go distance. This check can be used as a warning of any discrepancy in the rate of acceleration.

Go-No-Go Airspeed and Distance

In some cases the takeoff ground run is critical and requires careful preflight planning to assure safe operation in the event of an engine failure during takeoff. Various types of information, such as critical field length, critical engine failure speed, takeoff acceleration, acceleration check speeds, and refusal speed are provided the pilot to indicate the capabilities of the airplane during takeoff. The acceleration check speeds are used to indicate the acceleration progress of the airplane, whereas the refusal speed represents a definite point along the takeoff run at which the airplane may be stopped on the remaining runway in case of an engine failure. It must be remembered that the validity of the refusal speed is dependent upon a normal acceleration of the airplane. For this reason, the use of acceleration check speeds is important. It is evident that the above method of using acceleration check speeds to determine acceleration and refusal speed to decide whether or not to abort in case of engine failure can amount to several operations that must be accomplished in a matter of a few seconds. A simpler procedure may be used which combines the acceleration check with an approximate refusal speed. This procedure is the go-no-go concept. To obtain go-no-go speed (see definition), it is first necessary to obtain the zero-wind refusal speed. To establish an acceleration guide line on the Velocity During Takeoff Ground Run Chart (figure A3-5), use the takeoff speed and zero-wind ground run for the applicable gross weight and runway conditions. Enter the Velocity During Takeoff Ground Run Chart with the zero-wind refusal speed, go up to the predetermined guide line, and then proceed horizontally to the distance scale and read the zero-wind refusal distance. The first 1000-foot marker below this refusal distance is the go-no-go distance. Referring again to the acceleration guide line at the go-no-go distance, the zero-wind normal acceleration speed may be determined and then corrected for speed tolerance (figure A3-6) and for wind. This means that the airspeed at which the decision is made to abort is linked to an actual distance marker on the runway. This single marker serves both as a final acceleration check and a point of decision for the pilot to determine whether or not to continue the takeoff. If the refusal distance exceeds the takeoff distance, then the nearest 1000-foot marker below the takeoff distance is used for the go-no-go check. A chart is included to show tolerances for determining go-no-go speed for variable takeoff conditions.

Ground Effect

Ground effect, in general, refers to a reduction in the overall drag of an airplane when operated near the

RELATIONSHIP OF TAKEOFF TERMS

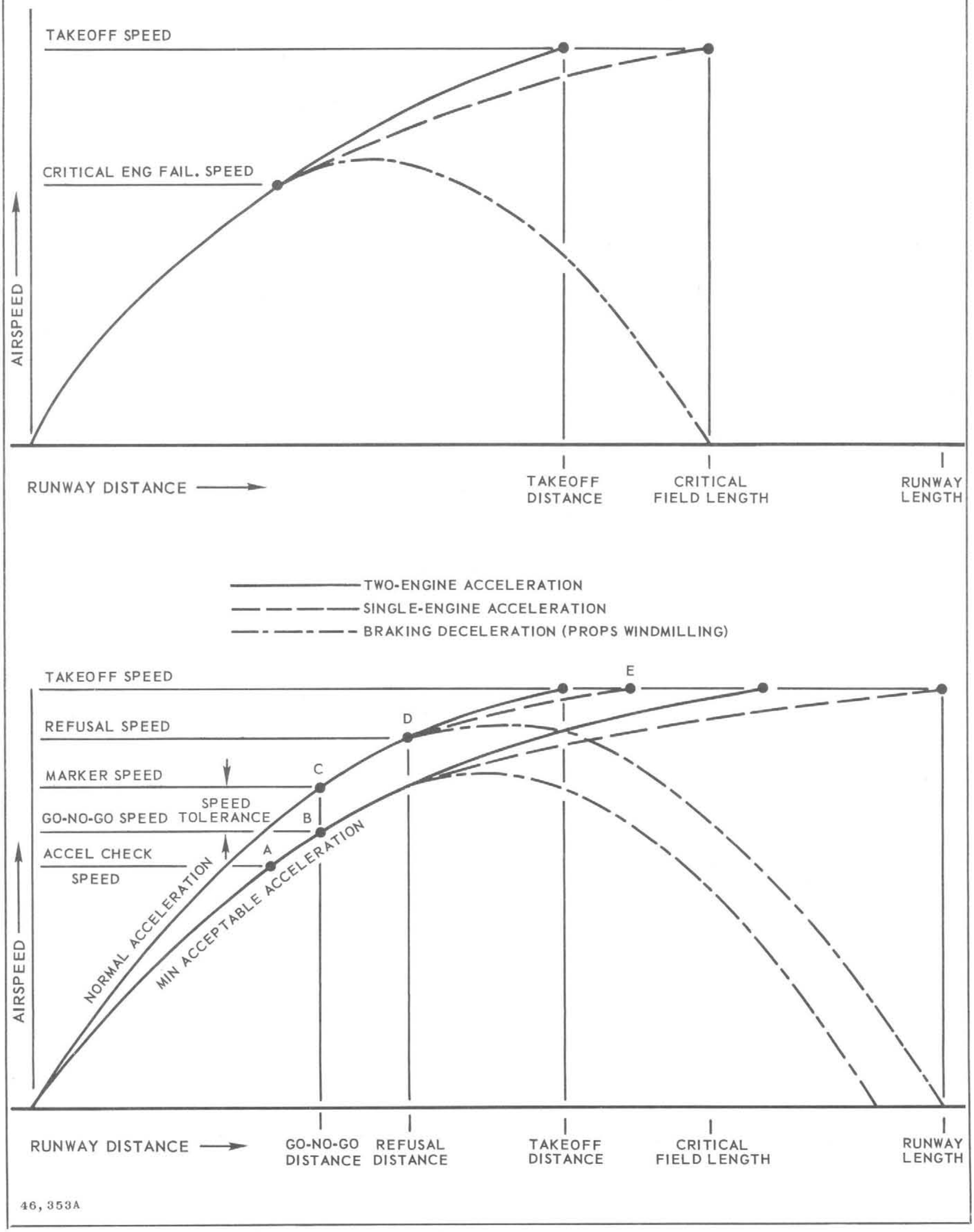


Figure A3-1

ground. The degree of drag reduction will vary with distance of the wing or supporting surface from the ground, being greatest when the wing is at ground level, and will have disappeared, for all practical purposes, when the wing is one-half its span above the ground. The reduction in drag is also greatest at low velocities and becomes less as velocity increases. All of the takeoff charts pertaining to the ground run consider the reduction in drag due to ground effect.

TAKEOFF PLANNING

An engine failure, while admittedly rare, remains a possibility, especially under takeoff (high power) conditions. If an engine should fail during the early part of a takeoff run, there is no problem — cut the remaining engine and stop. However, under certain conditions of weight, speed, and runway length, it is desirable to continue the takeoff. One of the purposes of the normal takeoff charts is to provide the necessary information to determine a desirable loading and wing flap setting and then to give an idea as to the amount of runway required and the rate of climb expected if an engine should fail during a late phase of the takeoff. An operation in which engine operation is normal will result in performance that greatly exceeds that indicated on these takeoff planning charts. In flight planning, the larger wing flap setting should be considered first. This is because the greater wing flap extensions result in reduced takeoff speed and required field length. The flap setting will be considered acceptable if (1) the rate of climb on the gross weight limited by climb chart is acceptable, and (2) if the critical field length found is equal to or less than the runway field length under consideration. If the rate of climb is too low, a lesser wing flap setting will then require a re-evaluation of the takeoff field length. If, after choosing the smallest recommended wing flap setting to obtain an acceptable initial rate of climb, it is found that the actual available runway field length is less than that shown on the chart, a reduction in gross weight is desirable. It is recommended that the airplane not be loaded so that the critical field length exceeds the available runway length. From the definition it can be seen that critical engine failure speed is required only when critical field length is equal to the available runway length, and since critical engine failure speed and refusal speed are equal in this case, then refusal speed is the only speed that need be monitored to determine whether or not to abort when encountering engine failure during takeoff. When the available field length is so much greater than the critical field length that the refusal speed is higher than takeoff speed, then the only speed that need be monitored during takeoff run is takeoff speed, and the decision to abort or continue the takeoff is determined by whether or not the airplane is airborne. The wind correction nomograms on the charts are calculated on the basis of 100% wind accountability. It is realized that wind differential ordinarily exists between the runway and the top of the control tower or building where the wind velocity reading is taken, the wind usually being a greater velocity at the higher altitude. Therefore headwinds reported by the tower should be used at one-half their value and tailwinds at one and one-half their value for takeoff, and at full value for conditions after takeoff.

DISCUSSION OF CHARTS

TAKEOFF AND LANDING CROSSWIND CHART

A Takeoff and Landing Crosswind Chart (figure A3-2) is provided to determine the runway headwind component from a given combination of wind direction and velocity.

EXAMPLE

Given:

Takeoff on runway 01 (10 degrees)
Wind = 070 degrees at 20 knots

Subtract the runway heading from the wind direction (70° − 10° = 60°). Enter the chart at zero wind (A) and follow 60° radial to 20 knots wind velocity line (B). Read down to crosswind component 17.5 knots (C). Read across from point (B) to headwind component 10 knots (D).

TAKEOFF GROSS WEIGHT LIMITED BY CLIMB

These charts (figure A3-3 and A3-4) present initial climb performance with one engine inoperative and its propeller feathered, and with continuous two-engine operation. Data are shown for approach flap settings as well as the basic takeoff flap settings. Single-engine rate of climb and two-engine rate of climb with landing gear retracted can be determined with any variable of wing flap setting, gross weight, TPSI, altitude, and temperature. The single-engine chart should be used for preflight planning to assure adequate rate of climb if an engine should fail during takeoff.

EXAMPLE

Given:

Density altitude = 1200 feet
Desired rate of climb = 300 fpm
TPSI = 128 psi
Gross weight = 42,000 pounds

To find the takeoff flap setting, enter the chart (figure A3-3) at density altitude of 1200 feet (A). Read across to 300 fpm rate of climb (B). Parallel guide lines to the sea level base line and then read up to TPSI 128 psi (C). Parallel the guide lines to the base line and read up to the takeoff gross weight (D). Read across to find takeoff flap setting of 12°.

Note

- For practical operation, limit the takeoff flap settings to either 12°, 6°, or 0°. Intermediate positions should be used only when one of these flap positions will not provide the required rate of climb and runway length combination.

- If the takeoff flap setting should come out as less than 0° under existing conditions, off-load as necessary to reduce the takeoff weight to that which allows the desired rate of climb. If the takeoff weight cannot be reduced, work backwards from the weight and minimum flap setting to determine the rate of climb.

INITIAL RATE OF CLIMB CORRECTION

This chart (Figure A3-4A) may be used to determine the initial takeoff rate of climb before the landing gear is retracted. The decrease in rate of climb obtained is due to the landing gear drag at takeoff. When takeoff conditions are critical, the rate of climb correction is applied to the takeoff gross weight limited by climb (Figure A3-3 and A3-4) to re-evaluate the allowable gross weight and/or desired rate of climb.

WARNING

This correction applies only during the initial takeoff until the landing gear is retracted. Landing gear retraction after takeoff is a normal requirement and is imperative with one engine inoperative, high temperatures, or high ground elevation. Refer to ENGINE FAILURE, Section III.

EXAMPLE

Given:

Gross weight = 42,000 pounds
Takeoff Flap setting = 12°
Density altitude = 1200 feet
Desired rate of climb (landing gear up) = 300 feet

Enter the chart at gross weight of 42,000 pounds (A). Proceed vertically to 12° flap line (B), then across to the base line of density altitude. Parallel the guide lines to density altitude 1200 feet (C), then across to read decrease in rate of climb, −255 fpm (D). This value, when subtracted from 300 fpm rate of climb used in determining gross weight limited by climb, results in a +45 fpm rate of climb with the landing gear down.

VELOCITY DURING TAKEOFF GROUND RUN

The acceleration speeds to be checked during the takeoff run may be obtained from the Velocity During Takeoff Ground Run Chart (figure A3-5). To use this chart, it is necessary to know the zero-wind ground run distance (corrected for runway slope) and the takeoff speed. By entering the chart with these two values, a guide line is established which represents the acceleration of the airplane during the takeoff run. After determining the proper acceleration curve, zero-wind acceleration check speeds may be chosen for any distance or time between brake release and takoff. On unmarkd runways or on marked runways under conditions of poor visibility, it is desirable to check the airplane's acceleration by relating speed to time. On marked runways under conditions in which the markers may be easily seen, it is preferable to determine acceleration by making an acceleration speed check at a given distance. Since the velocity is shown as indicated airspeed instead of true airspeed or ground speed, the time lines are shown for constant time divided by $\sqrt{\sigma}$. Thus, to determine acceleration time for altitudes and temperature conditions other than sea level and standard, the chart value must be divided by $\frac{1}{\sqrt{\sigma}}$. A wind nomogram is provided to obtain acceleration speeds for given wind conditions.

EXAMPLE

Given:

Takeoff speed = 114 knots
No-wind ground run (corrected for slope) = 3000 feet
No-wind refusal speed = 105 knots
½ reported headwind = 5 knots
Speed tolerance = −9 knots
Runway available = 5000 feet
Critical field length = 3850 feet
Go-no-go marker = 2000 feet

Enter the chart at no-wind ground run of 3000 feet (A), and takeoff speed of 114 knots (B). The point where these two lines intersect (C), will determine the acceleration curve. Enter the chart at the no-wind refusal speed of 105 knots (D), and read up to the acceleration curve (E). Point of intersection with the acceleration curve is refusal $T \times \frac{1}{\sqrt{\sigma}} = 27$ seconds for sea level standard atmosphere. Reading across, find refusal distance of 2400 feet (F). Enter the chart at the go-no-go marker point of 2000 feet (G), read across to the acceleration curve and then down to find no-wind normal acceleration (marker) speed of 98 knots (H). Correct the no-wind speed by subtracting the −9 knots speed tolerance obtained from the Speed Tolerance Chart (figure A3-6) to get go-no-go speed of 89 knots. Correct this figure for wind by entering wind nomogram with 89 knots on base line. Parallel guide line to headwind of 5 knots; proceed vertically to speed scale and read final corrected go-no-go speed of 93 knots.

SPEED TOLERANCE

The Speed Tolerance Chart (figure A3-6) may be used to determine speed tolerances at go-no-go and/or acceleration check runway markers. The values shown on the chart are based on the amount of runway available in excess of the critical field length up to a maximum tolerance of −10 knots. The maximum tolerance of −10 knots was selected as the limit in order to preclude takeoff in airplanes which do not meet minimum safe performance requirements. Therefore, when the speed is below the predicted acceleration check speed (minus tolerance), the takeoff should be aborted. The tolerances shown on the chart take into account variations in rolling friction, wind velocity, and other items that might retard normal acceleration; such as dragging brakes, improper flap setting, and wet runway. This chart, however, is not intended to account for reduced acceleration due to unacceptable engine performance. Minimum TPSI should always be observed and the takeoff should be aborted when it is not obtainable.

EXAMPLE

Given:

Critical field length = 3850 feet
Runway available = 5000 feet
Marker speed = 98 knots (IAS)

Enter chart at critical field length of 3850 feet (A), and read across to the runway available curve of 5000 feet (B), and then down to the marker acceleration speed line in the Speed Tolerance Chart (C). Proceed horizontally and read speed tolerance of −8.8 knots.

TAKEOFF AND BEST CLIMB SPEEDS

The Takeoff and Best Climb Speeds Chart (figure A3-7) is provided to show takeoff speeds, best climb speeds and 1.1 minimum control speeds. Takeoff speed is based on 120 percent of power-off stall speed or 110 percent of minimum control speed, whichever is greater. At low gross weights and larger flap settings, the minimum control speed becomes greater than the takeoff speed.

EXAMPLE

Given:

Gross weight = 42,000 pounds
Flap setting = 12°

Find takeoff speed by entering chart at gross weight of 42,000 pounds (A), and reading up to flap deflection of 12° (B). Read across to find speed of 114 knots (C). Find the speed for best rate of climb with two engines by entering the chart at gross weight of 42,000 pounds (A) and read up to the best climb speed line (0° to 20° flaps) (D). Read across to find speed of 133 knots (IAS).

Note

Speed for best rate of climb with single engine (0° to 20° flaps) is the same as 1.2 power off stall speed with 0° flaps.

CRITICAL FIELD LENGTH

The critical field length is defined as the distance in which the airplane can accelerate to critical engine failure speed on two engines and then either accelerate to takeoff on one engine or decelerate to a stop with brakes. To determine the critical field length, refer to figures A3-8, A3-11, A3-14, and A3-17.

EXAMPLE

Given:

Density altitude = 1200 feet
TPSI = 128 psi
Gross weight = 42,000 pounds
Runway slope = 1 percent up
½ reported headwind = 5 knots
Flap setting = 12°

Select chart for 12° flap (figure A3-11). Method of determining critical field length is the same as for computing takeoff ground run. For the conditions given above, critical field length, uncorrected for wind, would be 4150 feet. Applying correction for headwind, corrected critical field length would be 3850 feet (F).

REFUSAL SPEED

The refusal speed charts (figures A3-9, A3-12, A3-15, and A3-18) provide a means of determining the refusal speed for various conditions of gross weight, density altitude, TPSI, and wind. Refusal speed is the maximum speed at which takeoff may be aborted and the airplane brought to a complete stop within the remaining runway length, using brakes.

EXAMPLE

Given:

Density altitude = 1200 feet
TPSI = 128 psi
Gross weight = 42,000 pounds
Runway length = 5000 feet
½ reported headwind = 5 knots
Flap setting = 12°

Select chart for 12° flap (figure A3-12). Enter chart at runway length 5000 feet and read across to ½ reported headwind 5 knots (A). Follow guide line to base line and read across to 128 TPSI (B). Follow guide line to base line and read across to 1200 feet density altitude (C). Follow guide line to base line and read across to intersection of gross weight line from 42,000 pounds (D). Read refusal speed 108 knots IAS (E). Use the same procedure to obtain the no-wind refusal speed 105 knots IAS.

TAKEOFF GROUND RUN

Charts (figures A3-10, A3-13, A3-16, and A3-19) are provided to determine the ground run distance required from brake release to the point of takeoff for various conditions of gross weight, density altitude, wind, and TPSI for each takeoff flap setting. Under certain conditions where runway length is not critical but obstacle clearance is, takeoff with zero degrees flap may be utilized.

EXAMPLE

Given:

Density altitude = 1200 feet
TPSI = 128 psi
Gross weight = 42,000 pounds

- If the takeoff flap setting should come out as less than 0° under existing conditions, off-load as necessary to reduce the takeoff weight to that which allows the desired rate of climb. If the takeoff weight cannot be reduced, work backwards from the weight and minimum flap setting to determine the rate of climb.

INITIAL RATE OF CLIMB CORRECTION

This chart (Figure A3-4A) may be used to determine the initial takeoff rate of climb before the landing gear is retracted. The decrease in rate of climb obtained is due to the landing gear drag at takeoff. When takeoff conditions are critical, the rate of climb correction is applied to the takeoff gross weight limited by climb (Figure A3-3 and A3-4) to re-evaluate the allowable gross weight and/or desired rate of climb.

WARNING

This correction applies only during the initial takeoff until the landing gear is retracted. Landing gear retraction after takeoff is a normal requirement and is imperative with one engine inoperative, high temperatures, or high ground elevation. Refer to ENGINE FAILURE, Section III.

EXAMPLE

Given:

Gross weight = 42,000 pounds
Takeoff Flap setting = 12°
Density altitude = 1200 feet
Desired rate of climb (landing gear up) = 300 feet

Enter the chart at gross weight of 42,000 pounds (A). Proceed vertically to 12° flap line (B), then across to the base line of density altitude. Parallel the guide lines to density altitude 1200 feet (C), then across to read decrease in rate of climb, −255 fpm (D). This value, when subtracted from 300 fpm rate of climb used in determining gross weight limited by climb, results in a +45 fpm rate of climb with the landing gear down.

VELOCITY DURING TAKEOFF GROUND RUN

The acceleration speeds to be checked during the takeoff run may be obtained from the Velocity During Takeoff Ground Run Chart (figure A3-5). To use this chart, it is necessary to know the zero-wind ground run distance (corrected for runway slope) and the takeoff speed. By entering the chart with these two values, a guide line is established which represents the acceleration of the airplane during the takeoff run. After determining the proper acceleration curve, zero-wind acceleration check speeds may be chosen for any distance or time between brake release and takoff. On unmarkd runways or on marked runways under conditions of poor visibility, it is desirable to check the airplane's acceleration by relating speed to time. On marked runways under conditions in which the markers may be easily seen, it is preferable to determine acceleration by making an acceleration speed check at a given distance. Since the velocity is shown as indicated airspeed instead of true airspeed or ground speed, the time lines are shown for constant time divided by $\sqrt{\sigma}$. Thus, to determine acceleration time for altitudes and temperature conditions other than sea level and standard, the chart value must be divided by $\frac{1}{\sqrt{\sigma}}$. A wind nomogram is provided to obtain acceleration speeds for given wind conditions.

EXAMPLE

Given:

Takeoff speed = 114 knots
No-wind ground run (corrected for slope) = 3000 feet
No-wind refusal speed = 105 knots
½ reported headwind = 5 knots
Speed tolerance = −9 knots
Runway available = 5000 feet
Critical field length = 3850 feet
Go-no-go marker = 2000 feet

Enter the chart at no-wind ground run of 3000 feet (A), and takeoff speed of 114 knots (B). The point where these two lines intersect (C), will determine the acceleration curve. Enter the chart at the no-wind refusal speed of 105 knots (D), and read up to the acceleration curve (E). Point of intersection with the acceleration curve is refusal $T \times \frac{1}{\sqrt{\sigma}} = 27$ seconds for sea level standard atmosphere. Reading across, find refusal distance of 2400 feet (F). Enter the chart at the go-no-go marker point of 2000 feet (G), read across to the acceleration curve and then down to find no-wind normal acceleration (marker) speed of 98 knots (H). Correct the no-wind speed by subtracting the −9 knots speed tolerance obtained from the Speed Tolerance Chart (figure A3-6) to get go-no-go speed of 89 knots. Correct this figure for wind by entering wind nomogram with 89 knots on base line. Parallel guide line to headwind of 5 knots; proceed vertically to speed scale and read final corrected go-no-go speed of 93 knots.

SPEED TOLERANCE

The Speed Tolerance Chart (figure A3-6) may be used to determine speed tolerances at go-no-go and/or acceleration check runway markers. The values shown on the chart are based on the amount of runway available in excess of the critical field length up to a maximum tolerance of −10 knots. The maximum tolerance of −10 knots was selected as the limit in order to preclude takeoff in airplanes which do not meet minimum safe performance requirements. Therefore, when the speed is below the predicted acceleration check speed (minus tolerance), the takeoff should be aborted. The tolerances shown on the chart take into account variations in rolling friction, wind velocity, and other items that might retard normal acceleration; such as dragging brakes, improper flap setting, and wet runway. This chart, however, is not intended to account for reduced acceleration due to unacceptable engine performance. Minimum TPSI should always be observed and the takeoff should be aborted when it is not obtainable.

EXAMPLE

Given:

Critical field length = 3850 feet
Runway available = 5000 feet
Marker speed = 98 knots (IAS)

Enter chart at critical field length of 3850 feet (A), and read across to the runway available curve of 5000 feet (B), and then down to the marker acceleration speed line in the Speed Tolerance Chart (C). Proceed horizontally and read speed tolerance of −8.8 knots.

TAKEOFF AND MINIMUM CONTROL SPEEDS

The Takeoff and Minimum Control Speed Chart (figure A3-7) is provided to show takeoff speeds and 1.1 minimum control speeds. Takeoff speed is based on 120 percent of power-off stall speed or 110 percent of minimum control speed, whichever is greater. At low gross weights and larger flap settings, the minimum control speed becomes greater than the takeoff speed.

EXAMPLE

Given:

Gross weight = 42,000 pounds
Flap setting = 12°

Find takeoff speed by entering chart at gross weight of 42,000 pounds (A), and reading up to flap deflection of 12° (B). Read across to find speed of 114 knots (C).

CRITICAL FIELD LENGTH

The critical field length is defined as the distance in which the airplane can accelerate to critical engine failure speed on two engines and then either accelerate to takeoff on one engine or decelerate to a stop with brakes. To determine the critical field length, refer to figures A3-8, A3-11, A3-14, and A3-17.

EXAMPLE

Given:

Density altitude = 1200 feet
TPSI = 128 psi
Gross weight = 42,000 pounds
Runway slope = 1 percent up
½ reported headwind = 5 knots
Flap setting = 12°

Select chart for 12° flap (figure A3-11). Method of determining critical field length is the same as for computing takeoff ground run. For the conditions given above, critical field length, uncorrected for wind, would be 4150 feet. Applying correction for headwind, corrected critical field length would be 3850 feet (F).

REFUSAL SPEED

The refusal speed charts (figures A3-9, A3-12, A3-15, and A3-18) provide a means of determining the refusal speed for various conditions of gross weight, density altitude, TPSI, and wind. Refusal speed is the maximum speed at which takeoff may be aborted and the airplane brought to a complete stop within the remaining runway length, using brakes.

EXAMPLE

Given:

Density altitude = 1200 feet
TPSI = 128 psi
Gross weight = 42,000 pounds
Runway length = 5000 feet
½ reported headwind = 5 knots
Flap setting = 12°

Select chart for 12° flap (figure A3-12). Enter chart at runway length 5000 feet and read across to ½ reported headwind 5 knots (A). Follow guide line to base line and read across to 128 TPSI (B). Follow guide line to base line and read across to 1200 feet density altitude (C). Follow guide line to base line and read across to intersection of gross weight line from 42,000 pounds (D). Read refusal speed 108 knots IAS (E). Use the same procedure to obtain the no-wind refusal speed 105 knots IAS.

TAKEOFF GROUND RUN

Charts (figures A3-10, A3-13, A3-16, and A3-19) are provided to determine the ground run distance required from brake release to the point of takeoff for various conditions of gross weight, density altitude, wind, and TPSI for each takeoff flap setting. Under certain conditions where runway length is not critical but obstacle clearance is, takeoff with zero degrees flap may be utilized.

EXAMPLE

Given:

Density altitude = 1200 feet
TPSI = 128 psi
Gross weight = 42,000 pounds
Runway slope = 1 percent up
½ reported headwind = 5 knots
Flap setting = 12°

Select chart for 12° flap (figure A3-13). Enter chart at density altitude 1200 feet (A). Read up guide line to the 128 TPSI line (B). Read across to 42,000 pounds gross weight (C), and then down into the runway slope chart and follow the uphill curve to 1 percent (D). Read down and into the wind velocity chart. Follow the headwind curve to 5 knots (E), and read down to find corrected ground run of 2750 feet (F).

EFFECT OF RUNWAY SURFACE CONDITIONS

The stopping distance calculations for critical field length and refusal speed are based on an average coefficient of friction of 0.3; however, the actual runway surface may have a somewhat different coefficient of friction. For this reason, a chart (figure A3-20) is included which may be used to correct the distance values to conform to existing runway surface conditions.

EXAMPLE

Given:

Gross weight = 42,000 pounds
Critical field length = 3850 feet
Refusal speed = 108 KIAS
Runway condition = Snow

Enter chart at the coefficient of friction for snow and ice runway (A). Read across to gross weight in refusal speed portion of chart (B) and read down to find refusal speed correction factor K_{RS} 0.81 (C). Multiply refusal speed by K_{RS} factor to obtain refusal speed for runway condition. Follow same procedure to correct critical field length.

CLIMBOUT FACTOR FOR CLIMBOUT FLIGHT PATH

A Climbout Factor for Climbout Flight Path Chart (figure A3-21) is provided to determine the climbout factor for use with the climbout flight path charts. The chart presents a climbout factor based on gross weight, density altitude and torque pressure variation. The same climbout factor is used for computing the climbout flight path for two- and one-engine operation with either wet or dry power and with any flap setting.

EXAMPLE

Given:

Gross weight = 42,000 pounds
Density altitude = 1200 feet
TPSI = 128 psi

Enter the chart at gross weight of 42,000 pounds (A) and read up to density altitude of 1200 feet (B). Read across to 128 psi in the torque pressure curves (C) and then down to find the climbout factor of 5.5 (D). Use this factor on the appropriate climbout flight path chart to find the horizontal distance required to clear a given obstacle.

CLIMBOUT FLIGHT PATH

Climbout Flight Path Charts (figures A3-22 through A3-29) are provided to determine the horizontal distance required to clear a given obstacle from zero to 600 feet. The charts provide flight paths for climbout for two- and one-engine operation with either wet or dry power and with flap settings of either zero, 6, 12, or 24 degrees.

EXAMPLE

Given:

Obstacle height = 350 feet
Climbout factor = 5.5
1/2 reported headwind = 5 knots
Engines operating = Two
Flap setting = 12°

Enter the applicable Climbout Flight Path Chart (figure A3-24) at a height of 350 feet (A) and read across to the climbout factor of 5.5 (B). Read down to the wind correction grid base line; follow the headwind curve to five knots (C), and read down to find the distance from takeoff of 3100 feet (D).

MAXIMUM EFFORT

For maximum effort planning, the two-engine takeoff gross weight limited by climb, takeoff ground run, and METO power climb charts are used. These data represent maximum possible airplane performance regardless of the risks involved. The takeoff ground run and respective operational gross weights are predicated on the continued operation of both engines. When planning a takeoff using this information, consider the use of the lowest of the flap settings first.

Note

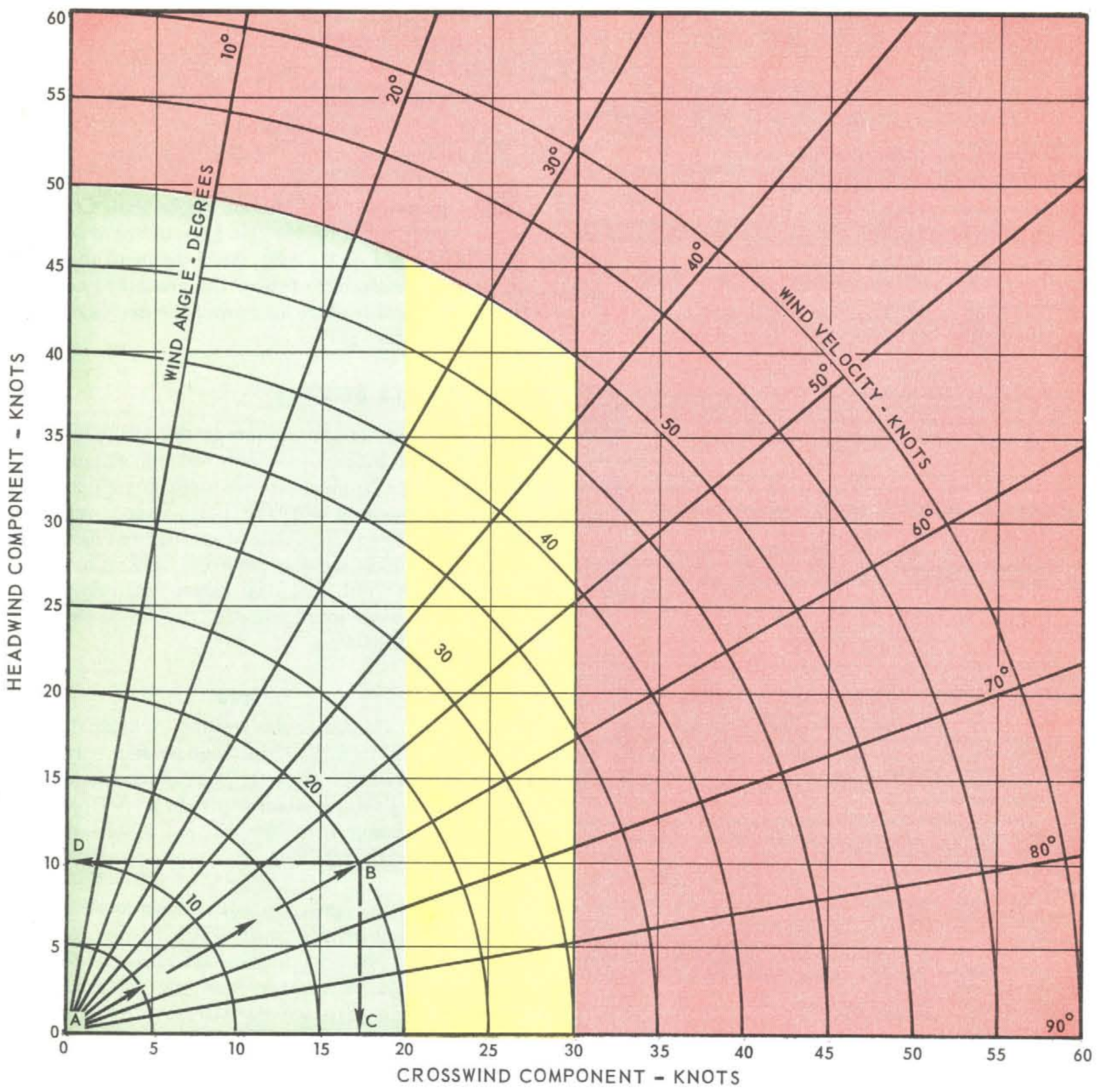
This procedure is the reverse of normal flight planning in which the highest flap setting is considered first. In maximum effort planning it is desirable to obtain the best performance (even though it is substandard) within the runway length available.

This setting will be acceptable if the takeoff ground run distance found on the chart is equal to or less than the length of the runway under consideration. If the required runway length is greater than the distance available, a greater wing flap setting will have to be considered. If, after checking all takeoff flap settings, the available takeoff runway is still too short, the gross weight will have to be reduced in order to operate from the field. A takeoff distance obtained from these charts is the distance from release of brakes to takeoff. In addition, each of the takeoff ground run charts has a correction factor that can be used to determine the distance required to clear a 50-foot obstacle.

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

TAKEOFF AND LANDING CROSSWIND CHART

ENGINES: R2800-99W



NOTE:

ENTER CHART WITH MAXIMUM GUST VELOCITY TO DETERMINE CROSSWIND COMPONENT.

🟩 RECOMMENDED
🟨 CAUTIONARY
🟥 NOT RECOMMENDED

46,310C

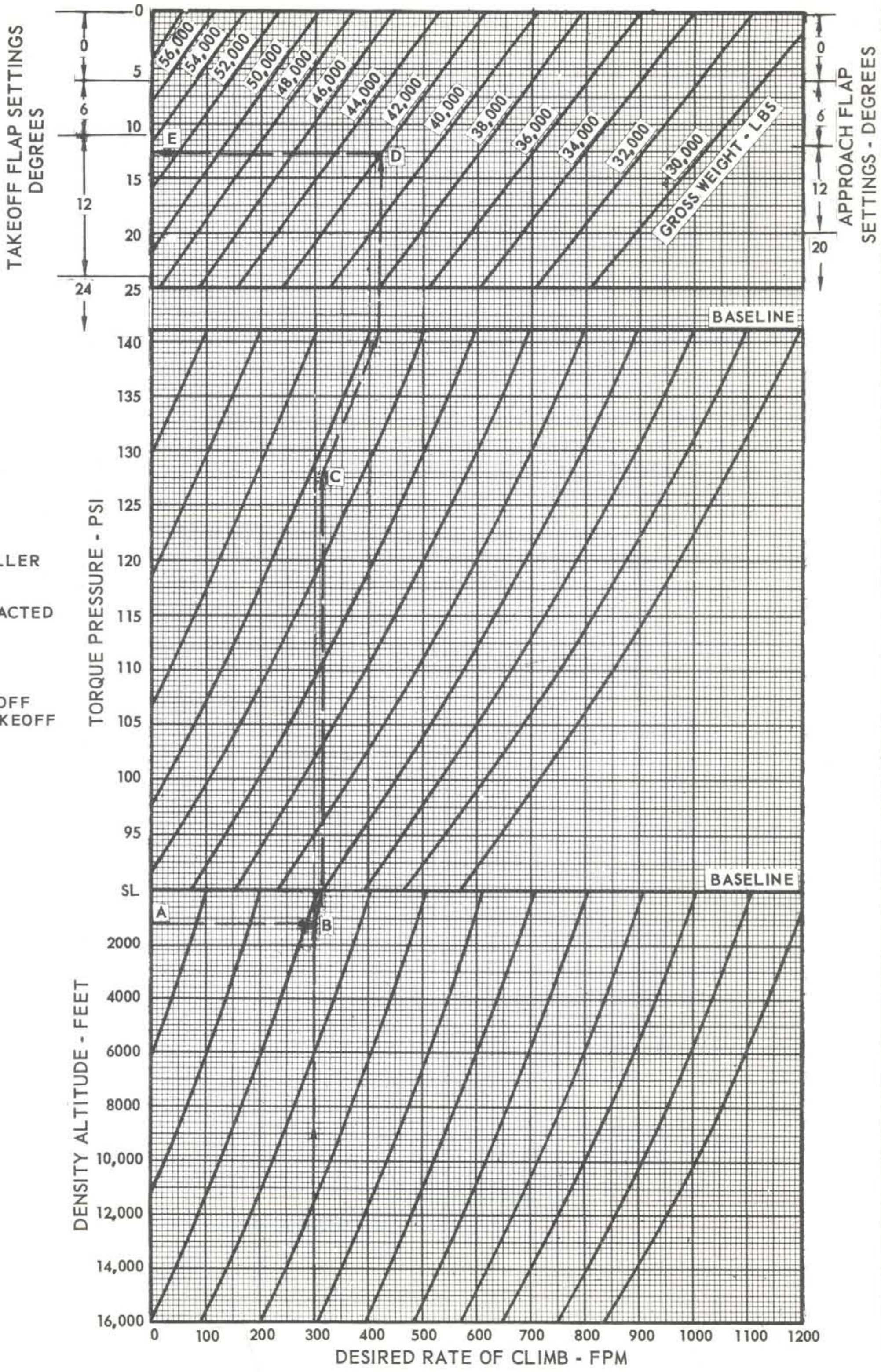
Figure A3-2

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

TAKEOFF GROSS WEIGHT LIMITED BY CLIMB

IF ONE ENGINE FAILS DURING TAKEOFF
LANDING GEAR UP 2800 RPM

ENGINES: R 2800-99W



NOTES:

(1) INOPERATIVE PROPELLER FEATHERED
(2) LANDING GEAR RETRACTED
(3) NACELLE FLAPS - MID-POSITION
(4) CLIMB SPEED = TAKEOFF SPEED (REFER TO TAKEOFF CURVES)

24,220C

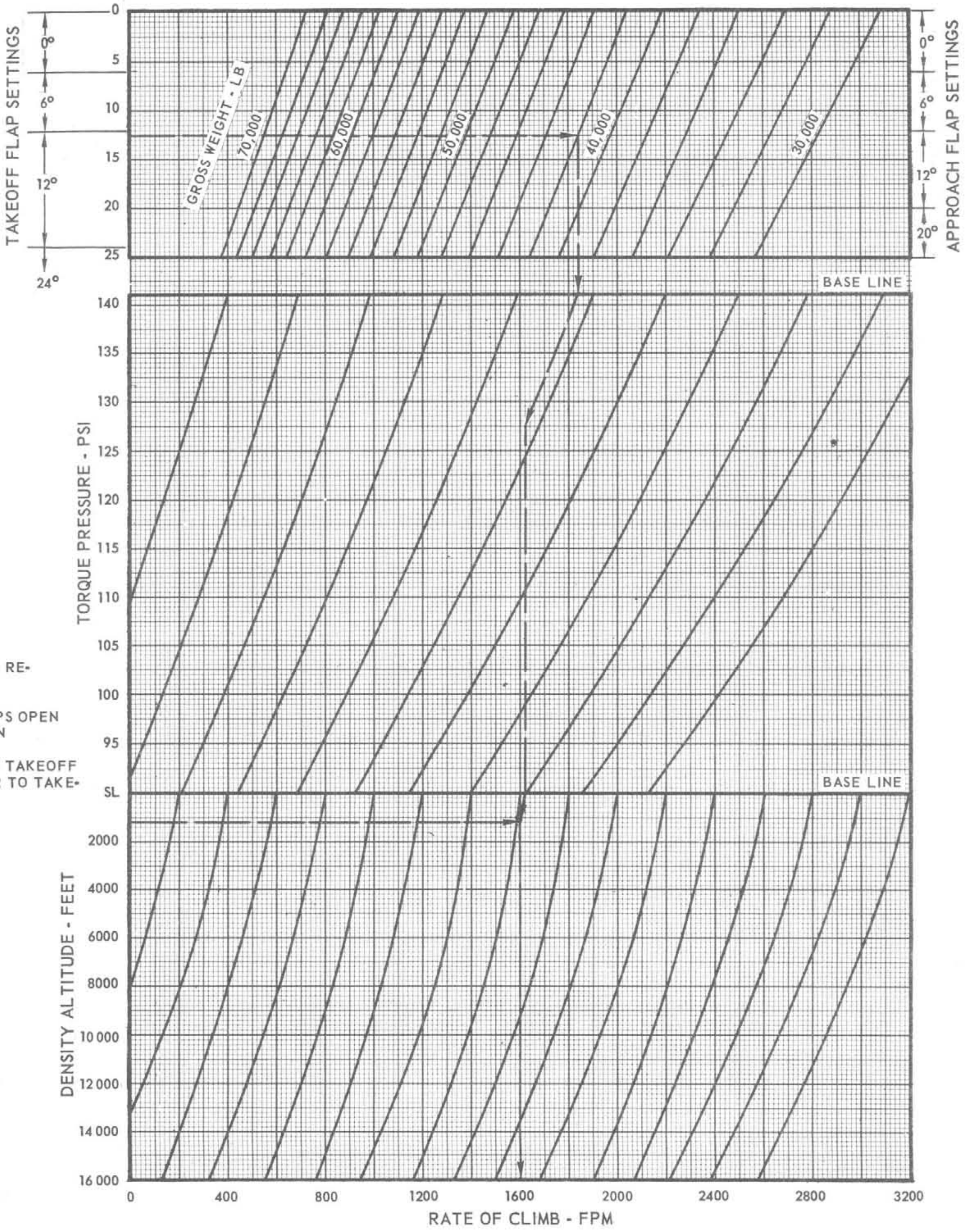
Figure A3-3

TAKEOFF GROSS WEIGHT LIMITED BY CLIMB

CONTINUOUS TWO ENGINE OPERATION
LANDING GEAR UP 2800 RPM

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

ENGINES: R2800-99W



NOTES:

(1) LANDING GEAR RETRACTED

(2) NACELLE FLAPS OPEN TO MIDPOSITION

(3) CLIMB SPEED = TAKEOFF SPEED. (REFER TO TAKEOFF CURVES.)

24,172B

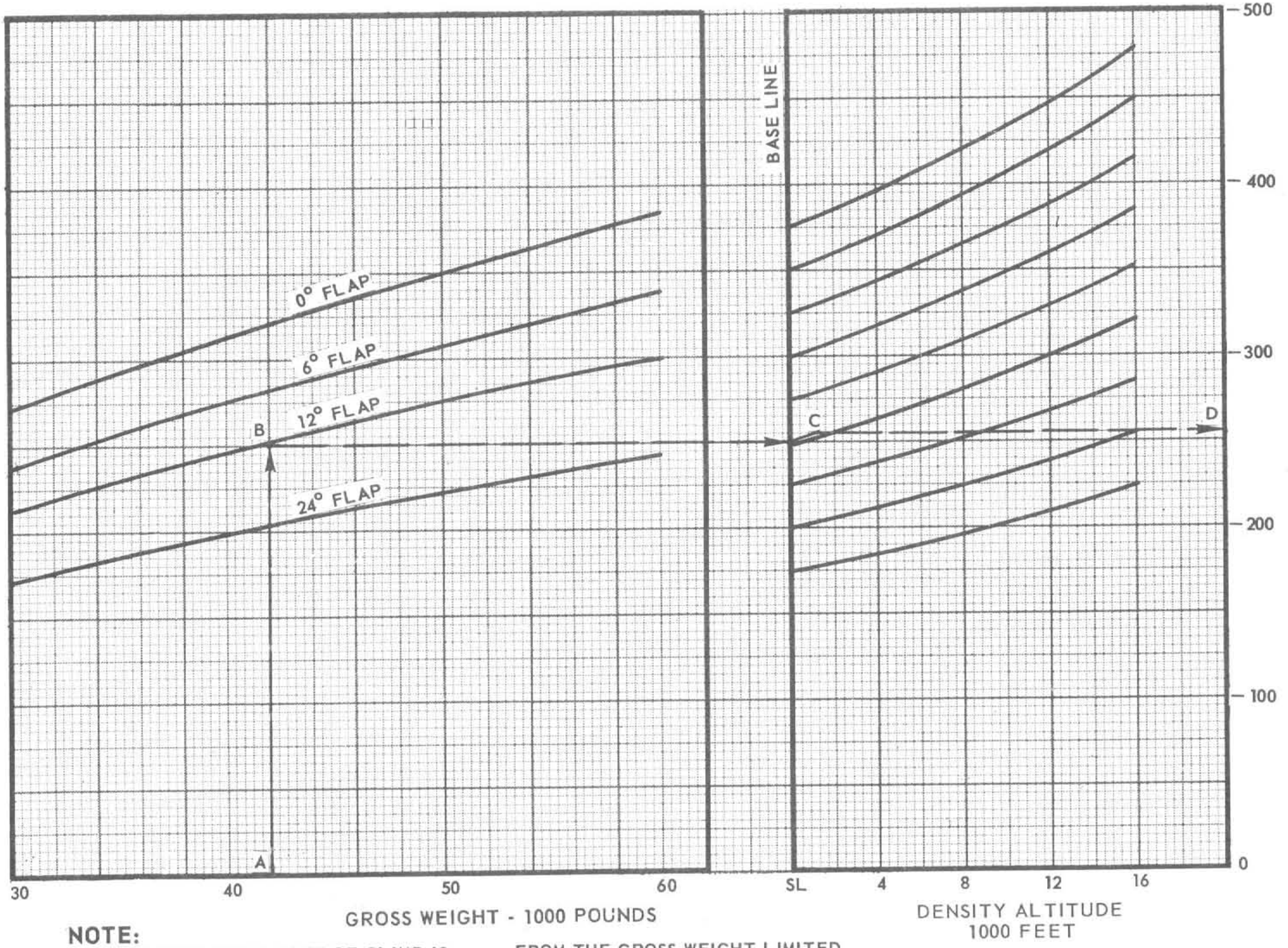
Figure A3-4

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

INITIAL RATE OF CLIMB CORRECTION

LANDING GEAR DOWN 2800 RPM

ENGINES: R2800-99W



NOTE:
THE DECREASE IN RATE OF CLIMB IS DUE TO LANDING GEAR DRAG AT TAKEOFF. THE CORRECTION IS APPLICABLE TO THE RATE OF CLIMB FROM THE GROSS WEIGHT LIMITED BY CLIMB CHARTS, SINGLE ENGINE AND TWO ENGINE.

24,173

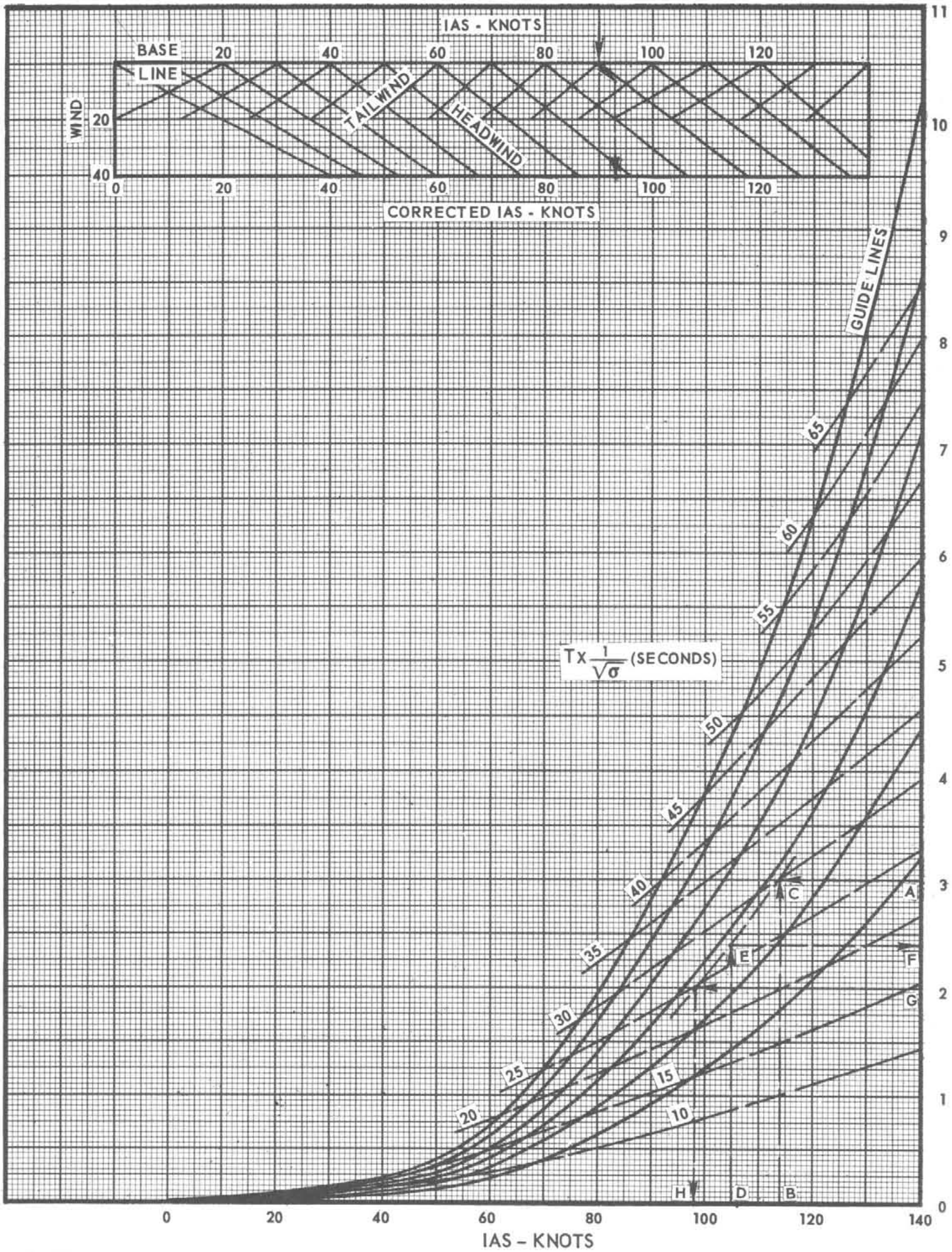
Figure A3-4A

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

VELOCITY DURING TAKEOFF GROUND RUN

(FOR ALL WEIGHTS AND FLAP SETTINGS)
2800 RPM

ENGINES: R2800-99W



NOTES:

1. DETERMINE GO-NO-GO SPEED FOR ZERO WIND CONDITIONS AND THEN CORRECT FOR HEADWIND OR TAILWIND.
2. 100% WIND ACCOUNTABILITY.
3. TIME LINES ARE FOR SEA LEVEL STANDARD CONDITIONS. TO OBTAIN TRUE TIME AT DENSITY ALTITUDE, DIVIDE $T \times \frac{1}{\sqrt{\sigma}}$ BY $\frac{1}{\sqrt{\sigma}}$.

45,456

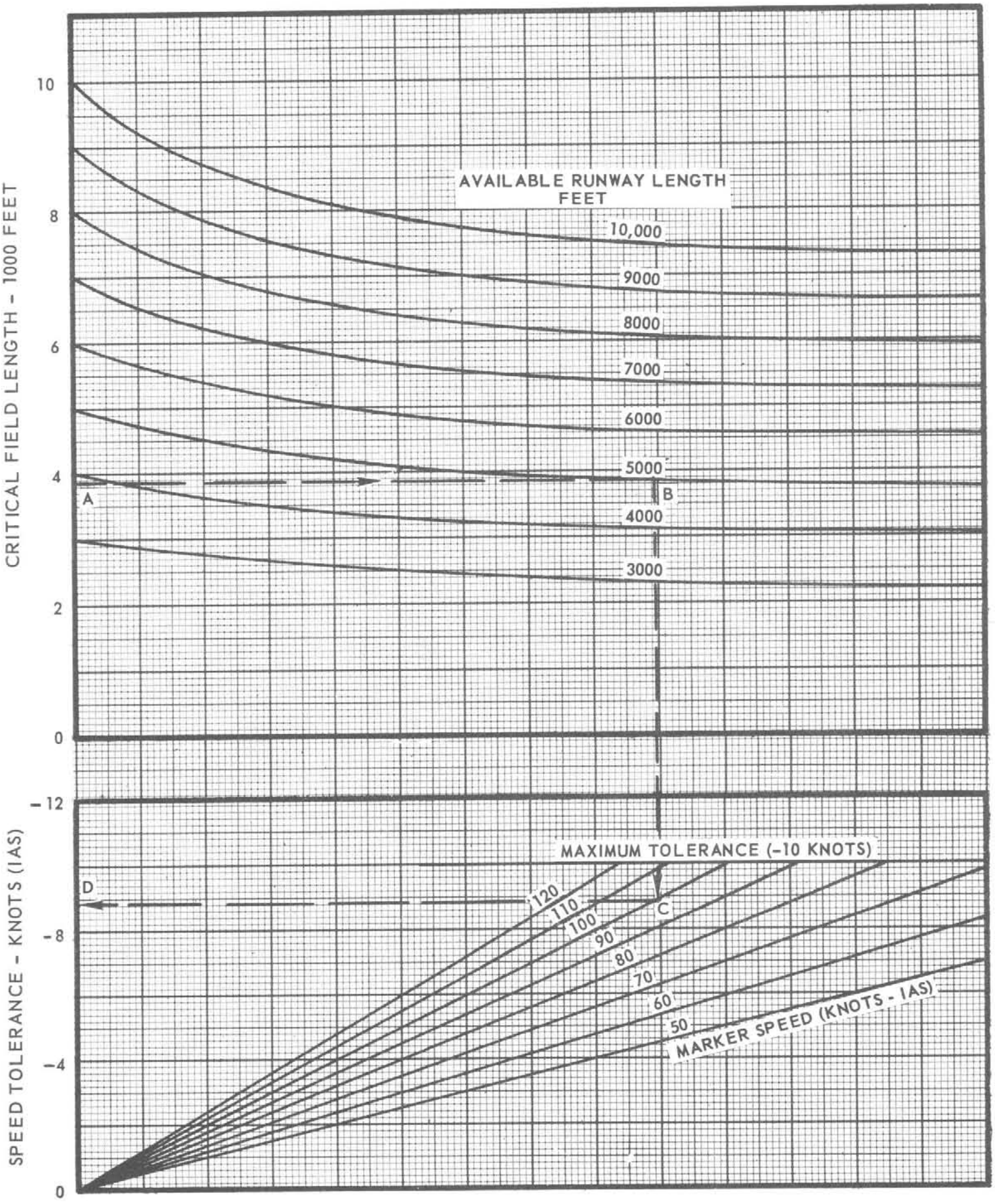
Figure A3-5

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

SPEED TOLERANCE

FOR ALL WEIGHTS AND FLAP SETTINGS
2800 RPM

ENGINES: R2800-99W

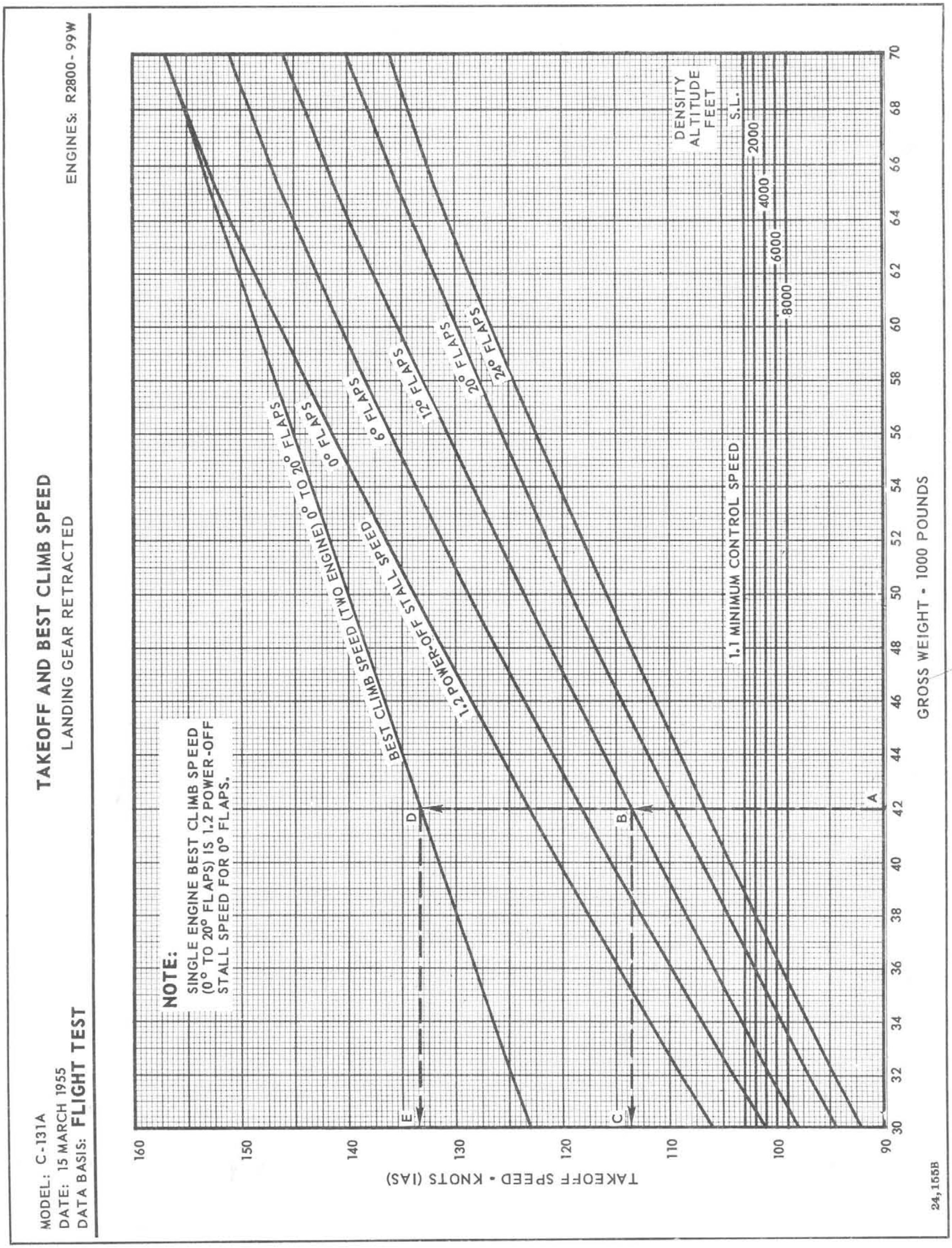


NOTE:

SUBTRACT SPEED TOLERANCE FROM NORMAL ACCELERATION SPEED AT THE GO-NO-GO MARKER (MARKER SPEED) TO OBTAIN GO-NO-GO SPEED.

45,458

Figure A3-6



TAKEOFF AND BEST CLIMB SPEED

LANDING GEAR RETRACTED

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

ENGINES: R2800-99W

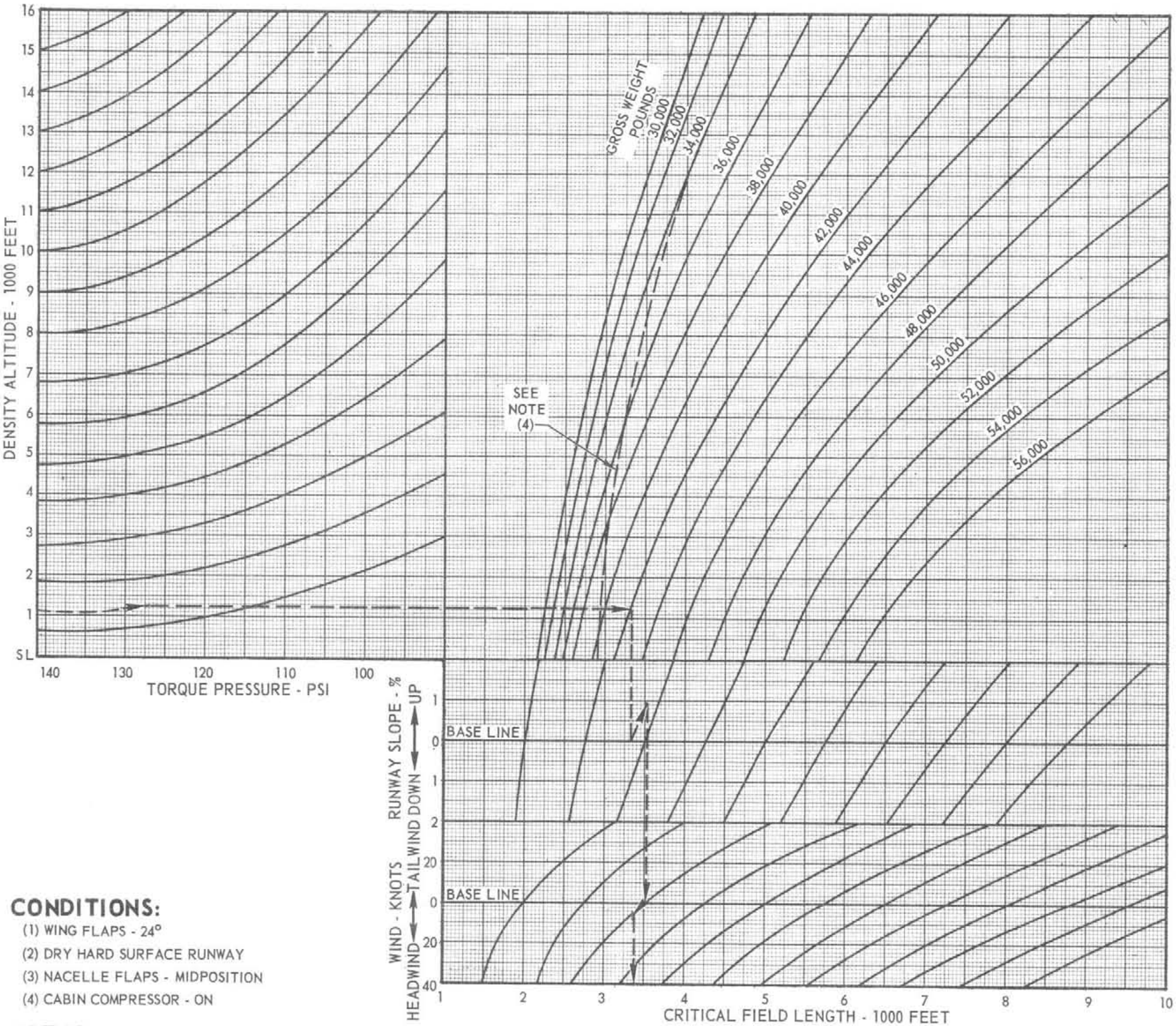
NOTE:
SINGLE ENGINE BEST CLIMB SPEED (0° TO 20° FLAPS) IS 1.2 POWER-OFF STALL SPEED FOR 0° FLAPS.

Figure A3-7

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CRITICAL FIELD LENGTH - 24° FLAP

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS - 24°

(2) DRY HARD SURFACE RUNWAY

(3) NACELLE FLAPS - MIDPOSITION

(4) CABIN COMPRESSOR - ON

NOTES:

(1) DISTANCES ARE BASED ON AUTOFEATHERING AT CRITICAL ENGINE FAILURE SPEED.

(2) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE TORQUE WILL BE 4.0 PSI LOWER.

(3) 100% WIND ACCOUNTABILITY.

(4) TAKEOFF SPEEDS ARE 1.2 STALL SPEEDS. BROKEN LINE REPRESENTS 1.1 MINIMUM CONTROL SPEED. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7

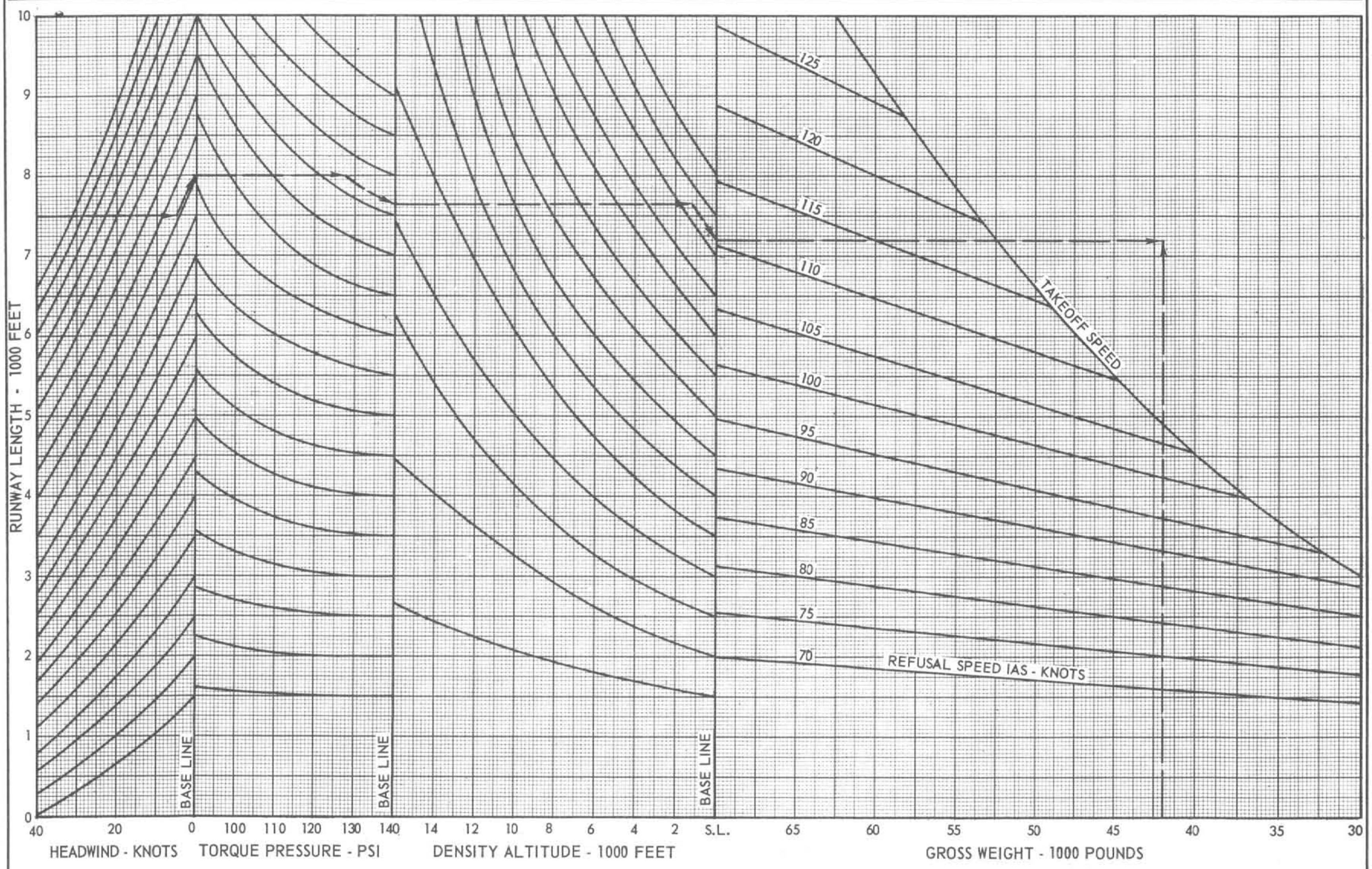
24,221B

Figure A3-8

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

REFUSAL SPEED - 24° FLAP

ENGINES: R-2800-99W



CONDITIONS: (1) WING FLAPS AT 24°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MIDPOSITION
(4) CABIN COMPRESSOR ON

NOTES: (1) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE
RIGHT ENGINE TORQUE PRESSURE WILL BE 4.0 PSI LOWER

(2) 100% REPORTED HEADWIND ACCOUNTABILITY

24, 189B

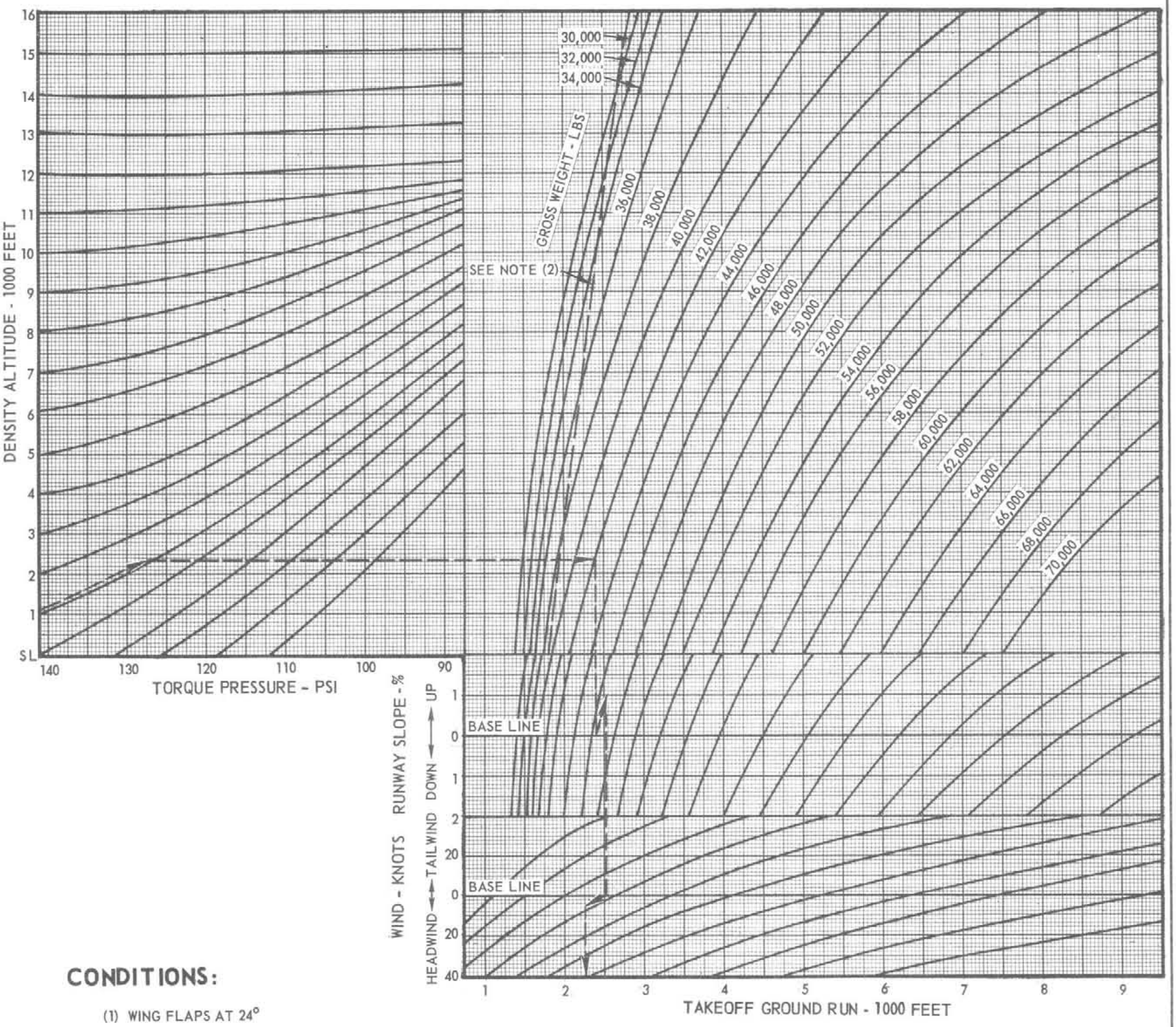
Figure A3-9

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

TAKEOFF GROUND RUN - 24° FLAP

CONTINUOUS TWO-ENGINE OPERATION

ENGINES: R 2800-99W



CONDITIONS:

(1) WING FLAPS AT 24°

(2) DRY HARD SURFACE RUNWAY

(3) NACELLE FLAPS MIDPOSITION

NOTES:

(1) DISTANCE TO CLEAR 50 FOOT OBSTACLE IS APPROXIMATELY 142% OF GROUND RUN DISTANCE.

(2) TAKEOFF SPEEDS ARE 1.2 STALL SPEEDS. BROKEN LINE REPRESENTS 1.1 MINIMUM CONTROL SPEED. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7.

(3) 100% WIND ACCOUNTABILITY.

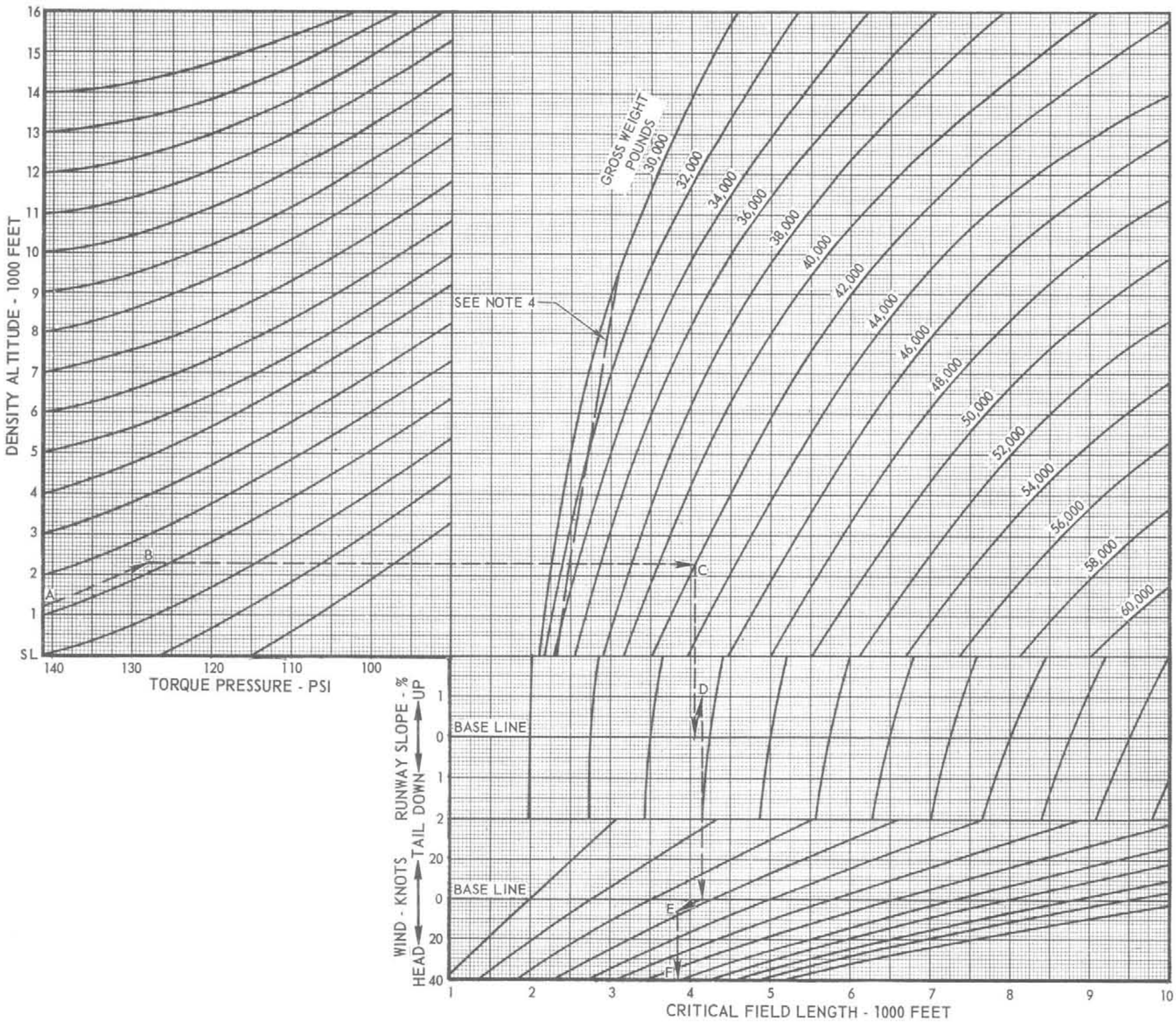
24,250B

Figure A3-10

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CRITICAL FIELD LENGTH - 12° FLAP

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS - 12°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS MIDPOSITION
(4) CABIN COMPRESSOR ON

NOTES:

(1) DISTANCES ARE BASED ON AUTO-FEATHERING AT CRITICAL ENGINE FAILURE SPEED.
(2) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE TORQUE WILL BE 4.0 PSI LOWER.
(3) 100% WIND ACCOUNTABILITY.
(4) TAKEOFF SPEEDS ARE 1.2 STALL SPEEDS. BROKEN LINE REPRESENTS 1.1 MINIMUM CONTROL SPEED. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7.

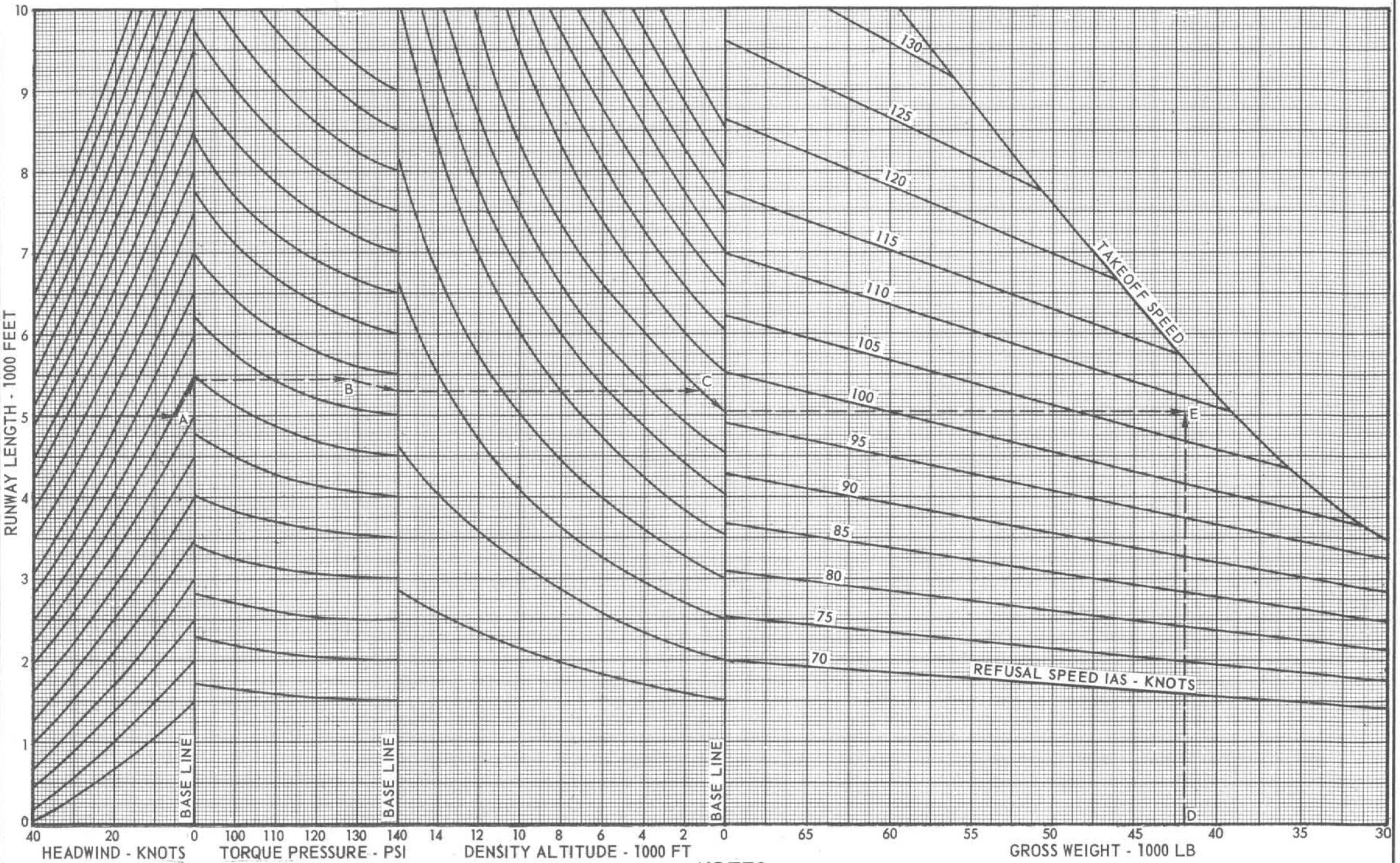
24,223B

Figure A3-11

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

REFUSAL SPEED - 12° FLAP

ENGINES: R-2800-99W



CONDITIONS: (1) WING FLAPS AT 12°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS MIDPOSITION
(4) CABIN COMPRESSOR ON

NOTES: (1) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE TORQUE PRESSURE WILL BE 4.0 PSI LOWER.
(2) 100% REPORTED HEADWIND ACCOUNTABILITY.

24,222C

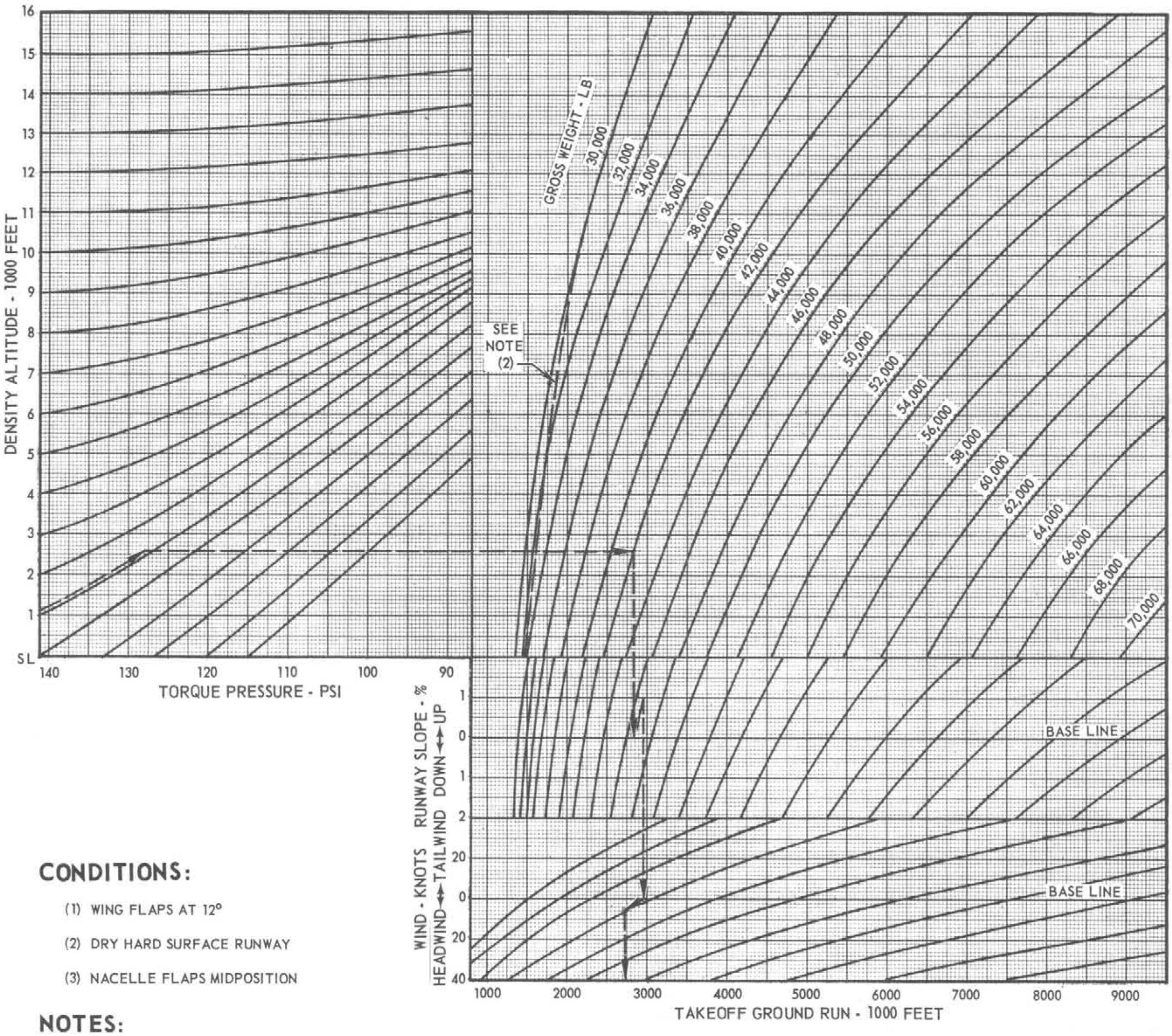
Figure A3-12

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

TAKEOFF GROUND RUN - 12° FLAP

CONTINUOUS TWO ENGINE OPERATION

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS AT 12°

(2) DRY HARD SURFACE RUNWAY

(3) NACELLE FLAPS MIDPOSITION

NOTES:

(1) DISTANCE TO CLEAR 50 FOOT OBSTACLE IS APPROXIMATELY 139% OF GROUND RUN DISTANCE

(2) TAKEOFF SPEEDS ARE 1.2 STALL SPEEDS. BROKEN LINE REPRESENTS 1.1 MINIMUM CONTROL SPEED. (SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7.)

(3) 100% WIND ACCOUNTABILITY

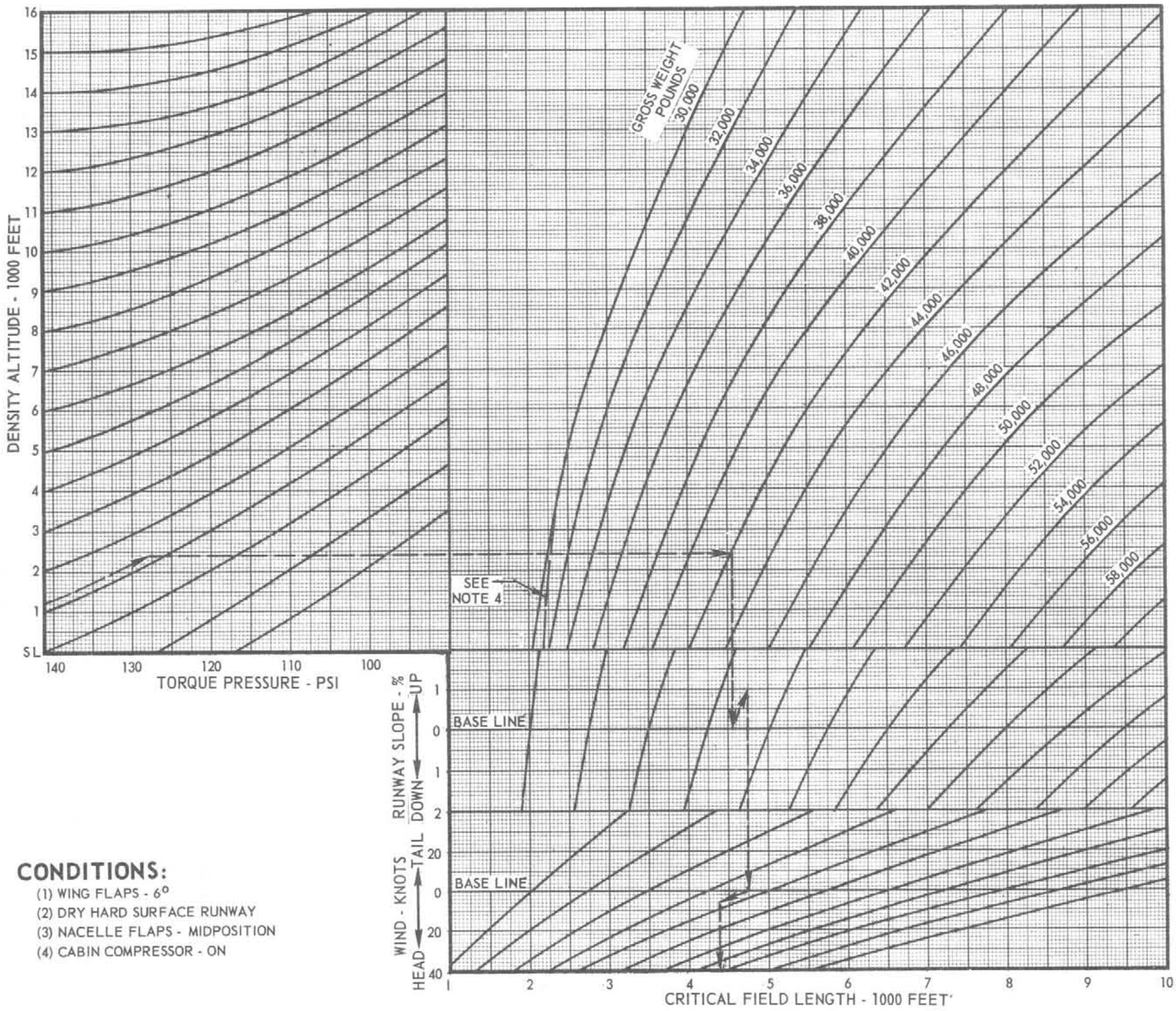
24,249B

Figure A3-13

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CRITICAL FIELD LENGTH - 6° FLAP

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS - 6°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MIDPOSITION
(4) CABIN COMPRESSOR - ON

NOTES:

(1) DISTANCES ARE BASED ON AUTO-FEATHERING AT CRITICAL ENGINE FAILURE SPEED.
(2) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE WILL BE 4.0 PSI LOWER.
(3) 100% WIND ACCOUNTABILITY.
(4) TAKEOFF SPEEDS ARE 1.2 STALL SPEED. BROKEN LINE REPRESENTS 1.1 MINIMUM CONTROL SPEED. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7.

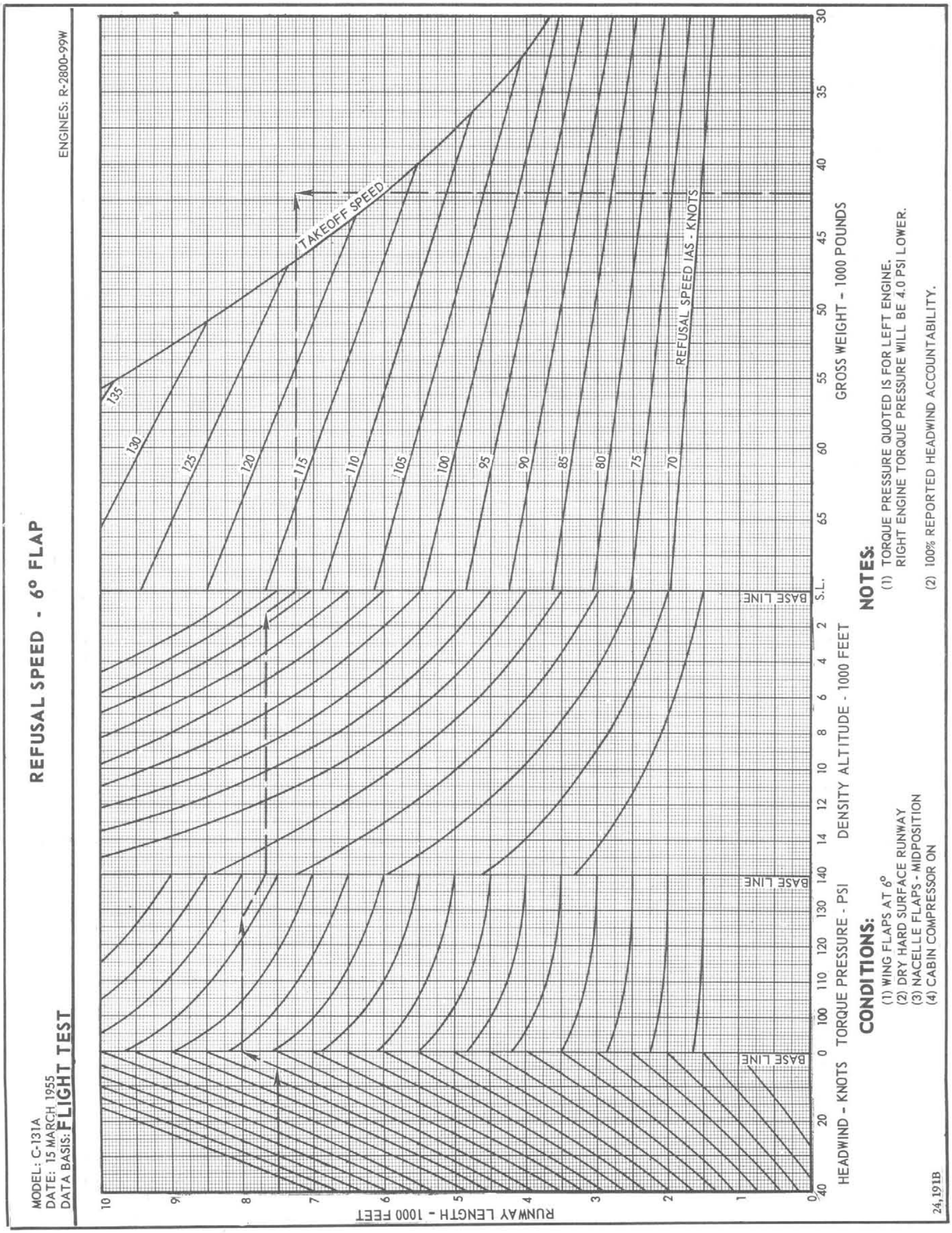
24,224B

Figure A3-14

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

ENGINES: R-2800-99W

REFUSAL SPEED - 6° FLAP



CONDITIONS:
(1) WING FLAPS AT 6°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MIDPOSITION
(4) CABIN COMPRESSOR ON

NOTES:
(1) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE TORQUE PRESSURE WILL BE 4.0 PSI LOWER.
(2) 100% REPORTED HEADWIND ACCOUNTABILITY.

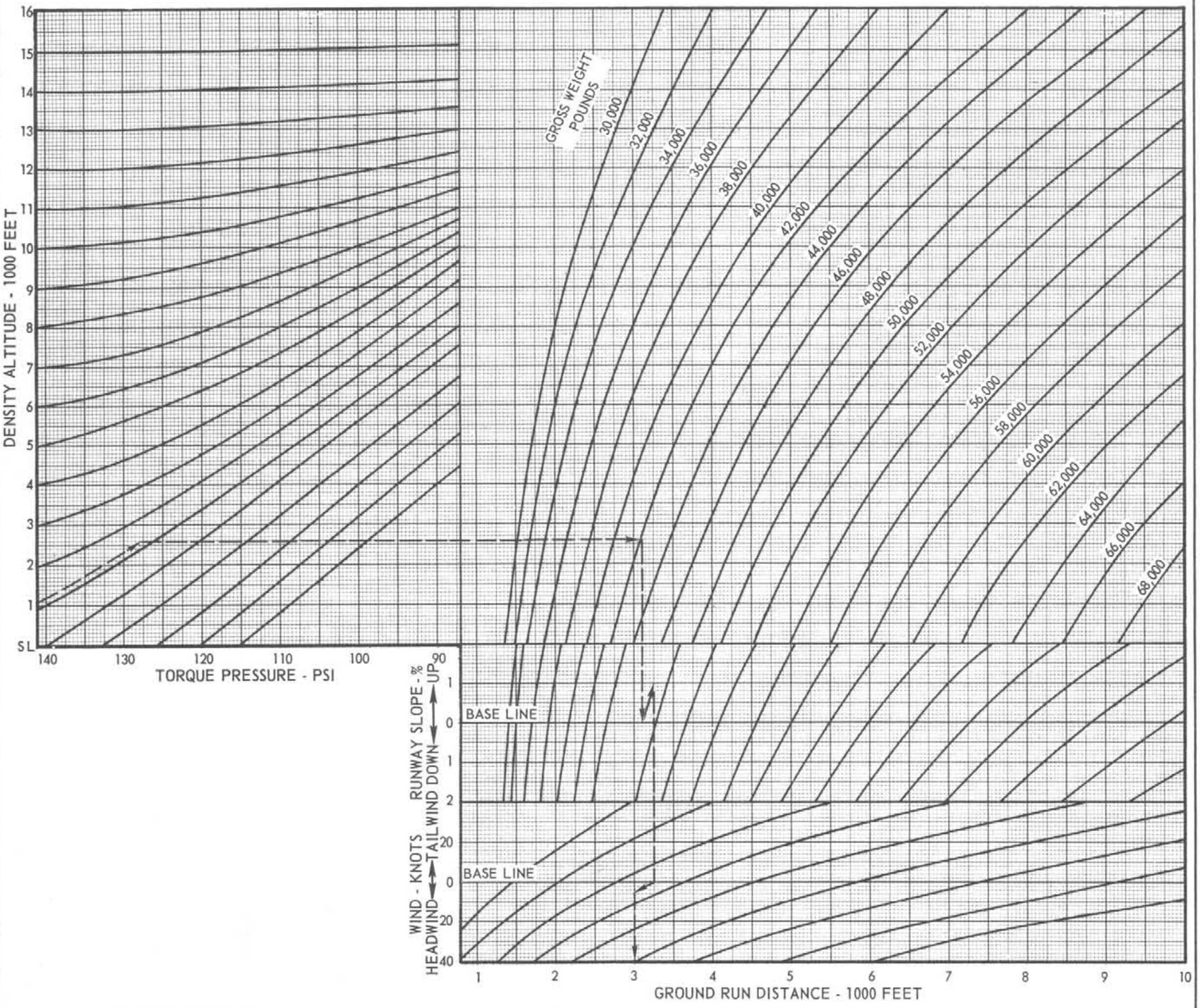
24,191B

Figure A3-15

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

TAKEOFF GROUND RUN - 6° FLAP

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS AT 6°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MIDPOSITION

NOTES:

(1) DISTANCE TO CLEAR 50 FOOT OBSTACLE IS APPROXIMATELY 138% OF GROUND RUN DISTANCE.
(2) TAKEOFF SPEEDS ARE 1.2 STALL SPEEDS. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7

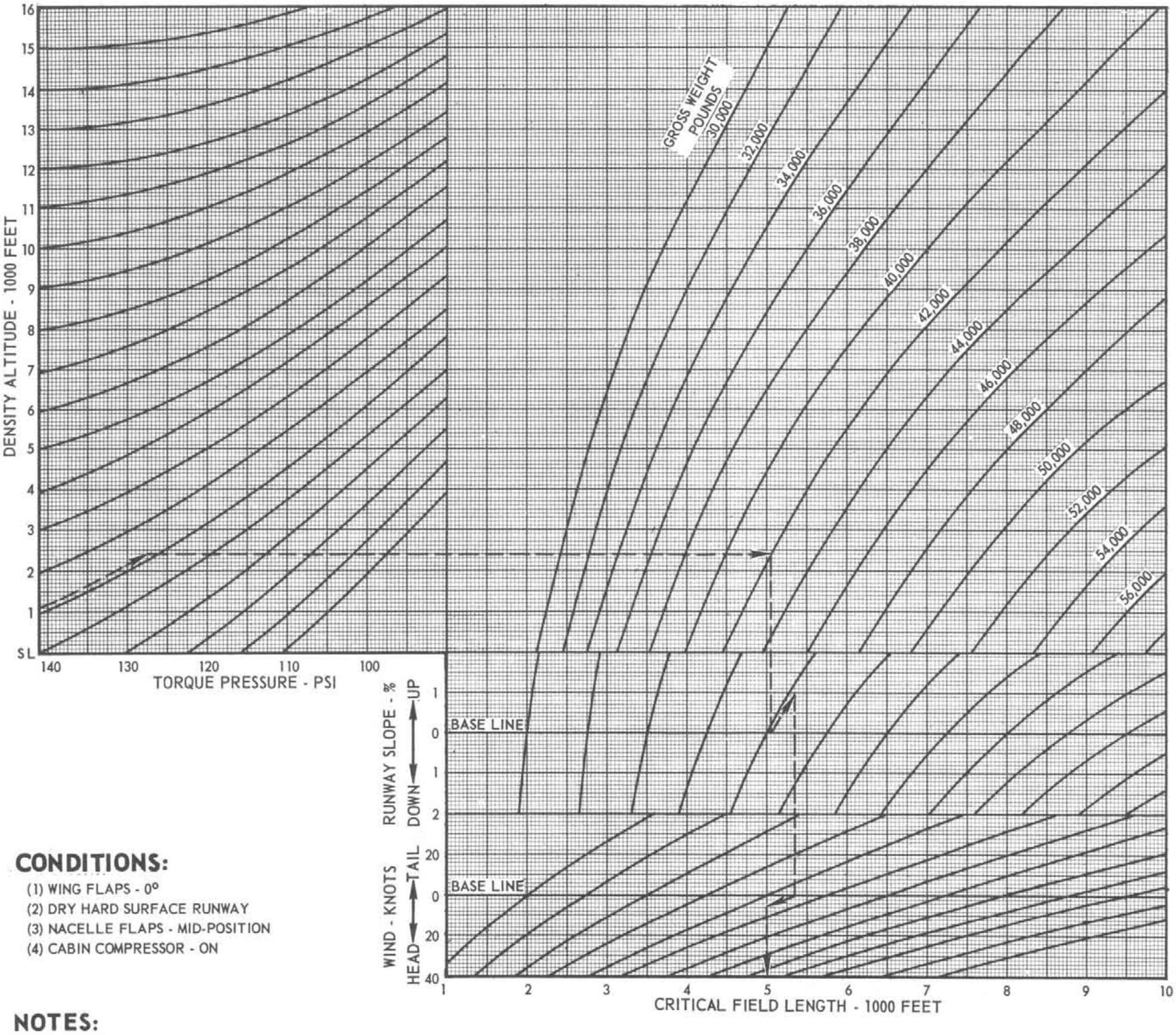
24,192A

Figure A3-16

CRITICAL FIELD LENGTH - 0° FLAP

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS - 0°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MID-POSITION
(4) CABIN COMPRESSOR - ON

NOTES:

(1) DISTANCES ARE BASED ON AUTO-FEATHERING AT CRITICAL ENGINE FAILURE SPEED.
(2) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE TORQUE WILL BE 4.0 PSI LOWER.
(3) 100% WIND ACCOUNTABILITY.
(4) TAKEOFF SPEEDS ARE 1.2 STALL SPEED. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART. FIGURE A3-7.

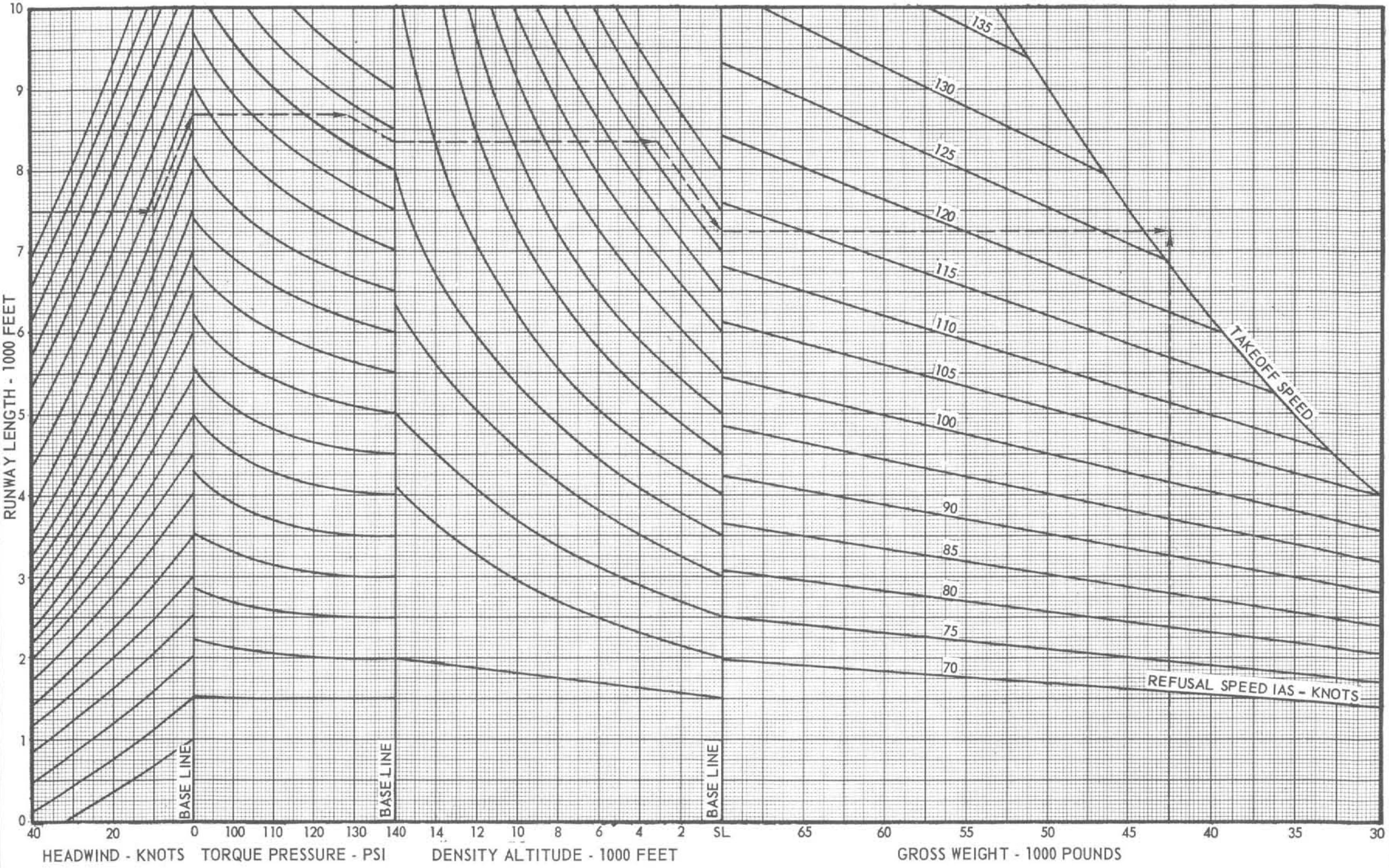
24,226B

Figure A3-17

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

REFUSAL SPEED - 0° FLAP

ENGINES: R2800-99W



CONDITIONS:
(1) WING FLAPS AT 0°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MIDPOSITION
(4) CABIN COMPRESSOR ON

NOTES:
(1) TORQUE PRESSURE QUOTED IS FOR LEFT ENGINE. RIGHT ENGINE TORQUE PRESSURE WILL BE 4.0 PSI LOWER.
(2) 100% REPORTED HEADWIND ACCOUNTABILITY.

24,225C

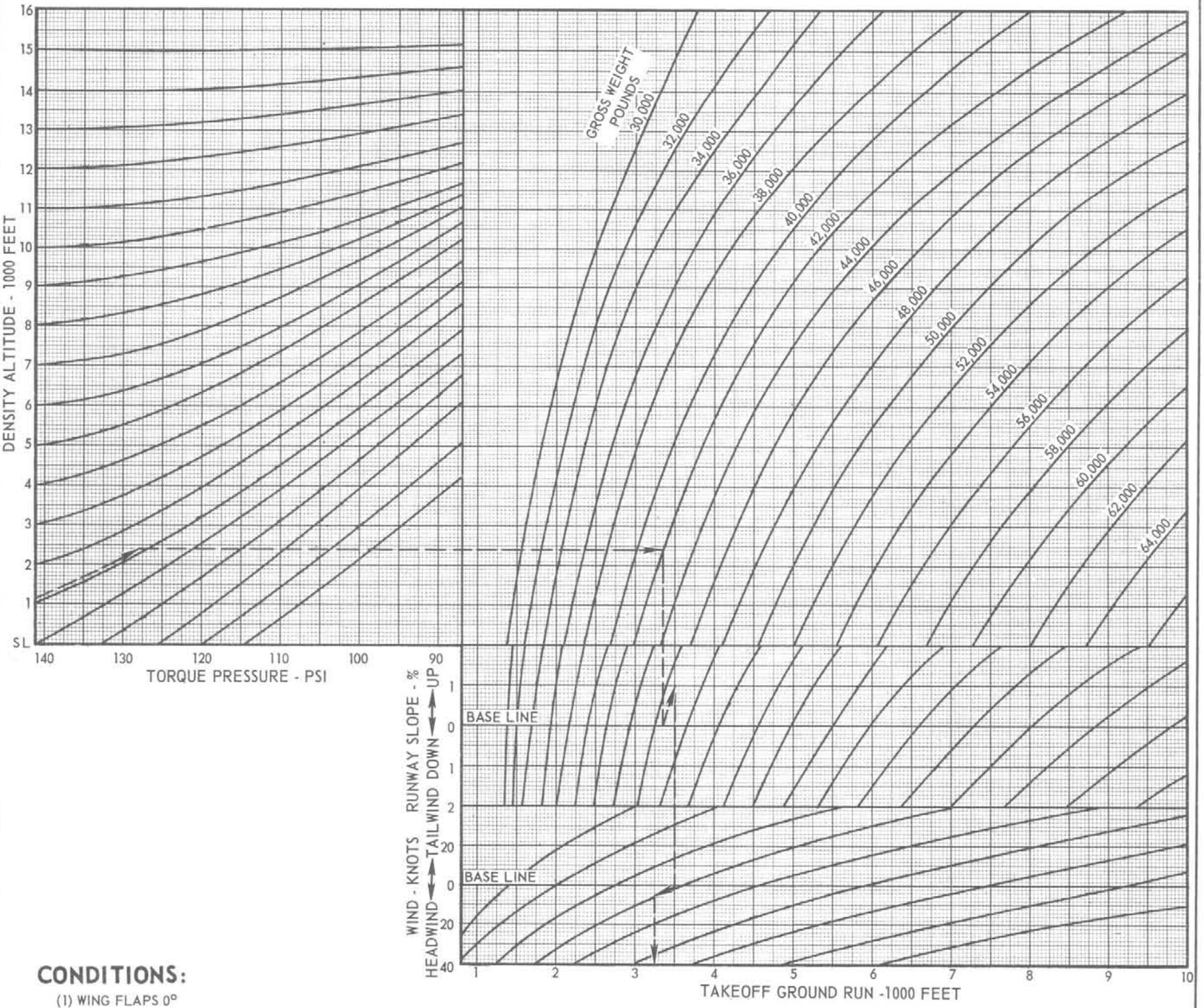
Figure A3-18

MODEL: C131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

TAKEOFF GROUND RUN - 0° FLAP

CONTINUOUS TWO ENGINE OPERATION

ENGINES: R2800-99W



CONDITIONS:

(1) WING FLAPS 0°
(2) DRY HARD SURFACE RUNWAY
(3) NACELLE FLAPS - MIDPOSITION

NOTES:

(1) DISTANCE TO CLEAR 50 FOOT OBSTACLE IS APPROXIMATELY 136% OF GROUND RUN DISTANCE.
(2) TAKEOFF SPEEDS ARE 1.2 STALL SPEEDS. SEE TAKEOFF AND MINIMUM CONTROL SPEED CHART, FIGURE A3-7.
(3) 100% WIND ACCOUNTABILITY.

24,248B

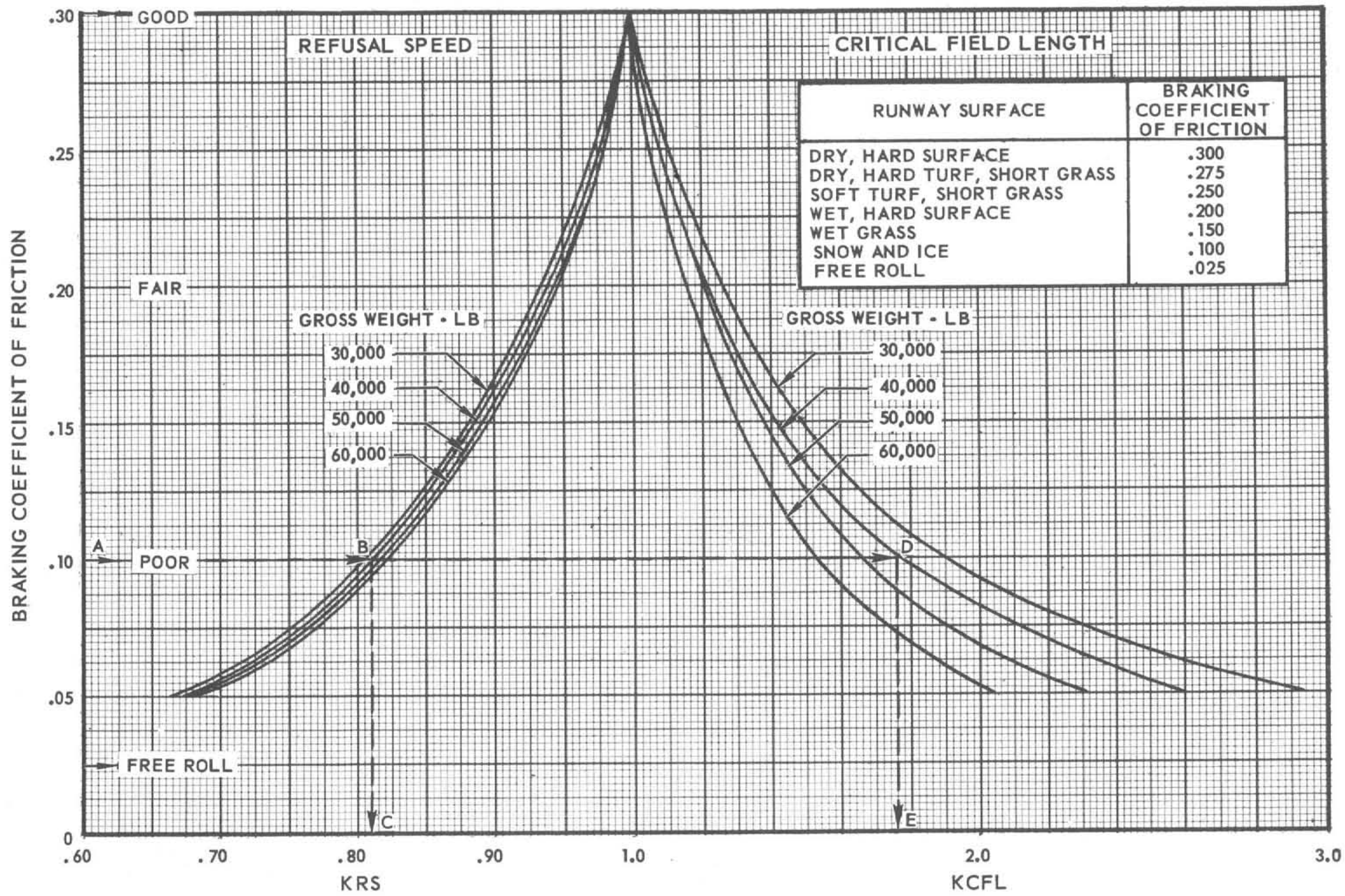
Figure A3-19

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

EFFECT OF RUNWAY SURFACE CONDITIONS

REFUSAL SPEED AND CRITICAL FIELD LENGTH CORRECTIONS
ALL FLAP SETTINGS

ENGINES: R2800-99W



RUNWAY SURFACE	BRAKING COEFFICIENT OF FRICTION
DRY, HARD SURFACE	.300
DRY, HARD TURF, SHORT GRASS	.275
SOFT TURF, SHORT GRASS	.250
WET, HARD SURFACE	.200
WET GRASS	.150
SNOW AND ICE	.100
FREE ROLL	.025

CORRECTED REFUSAL SPEED = K_{RS} × REFUSAL SPEED FROM CHARTS

CORRECTED CRITICAL FIELD LENGTH = K_{CFL} × CRITICAL FIELD LENGTH FROM CHARTS

24,156A

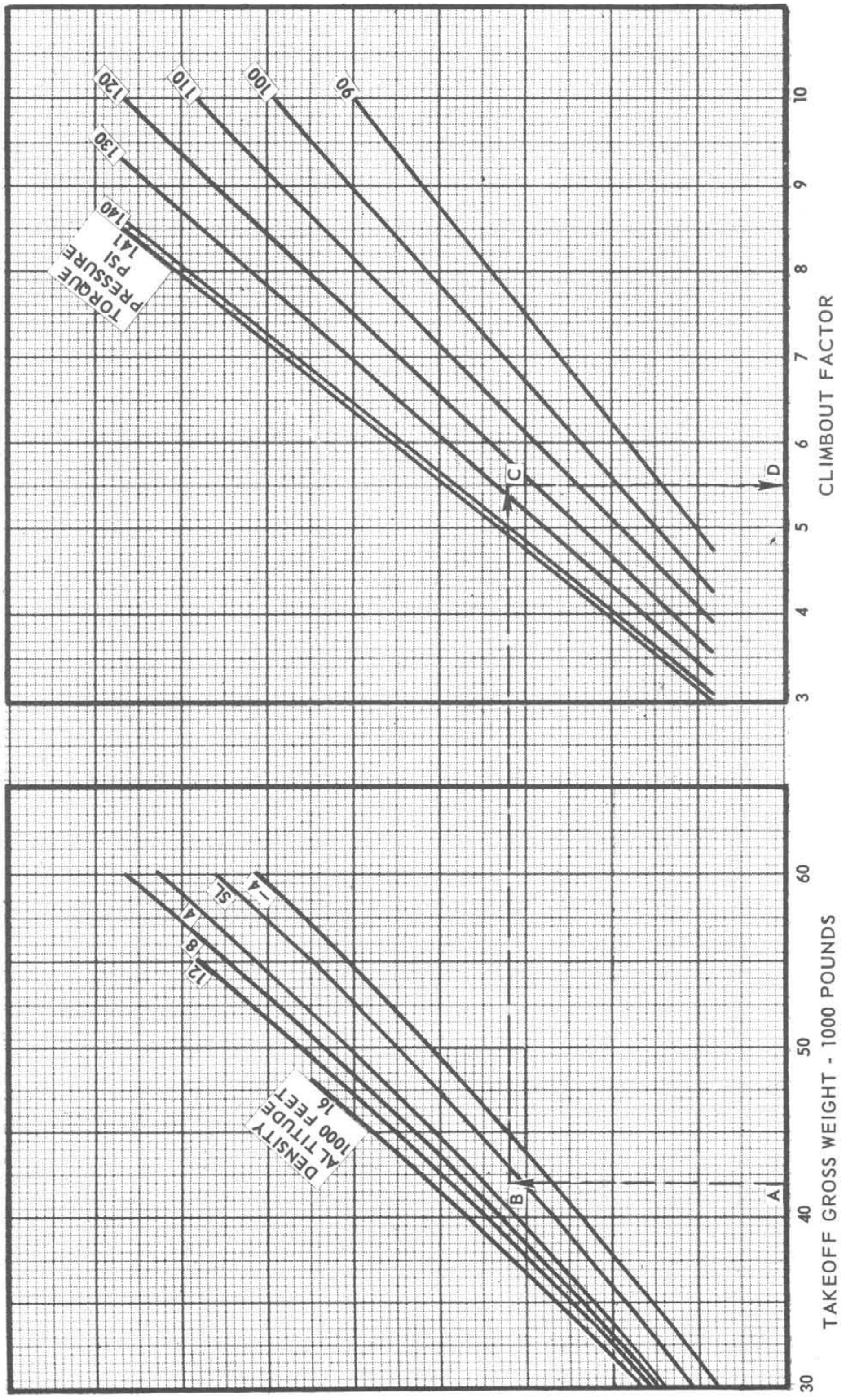
Figure A3-20

CLIMBOUT FACTOR FOR CLIMBOUT FLIGHT PATH

FOR ALL FLAP SETTINGS 2800 RPM TWO AND ONE ENGINE OPERATION

ENGINES: R2800-99W

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**



24,180

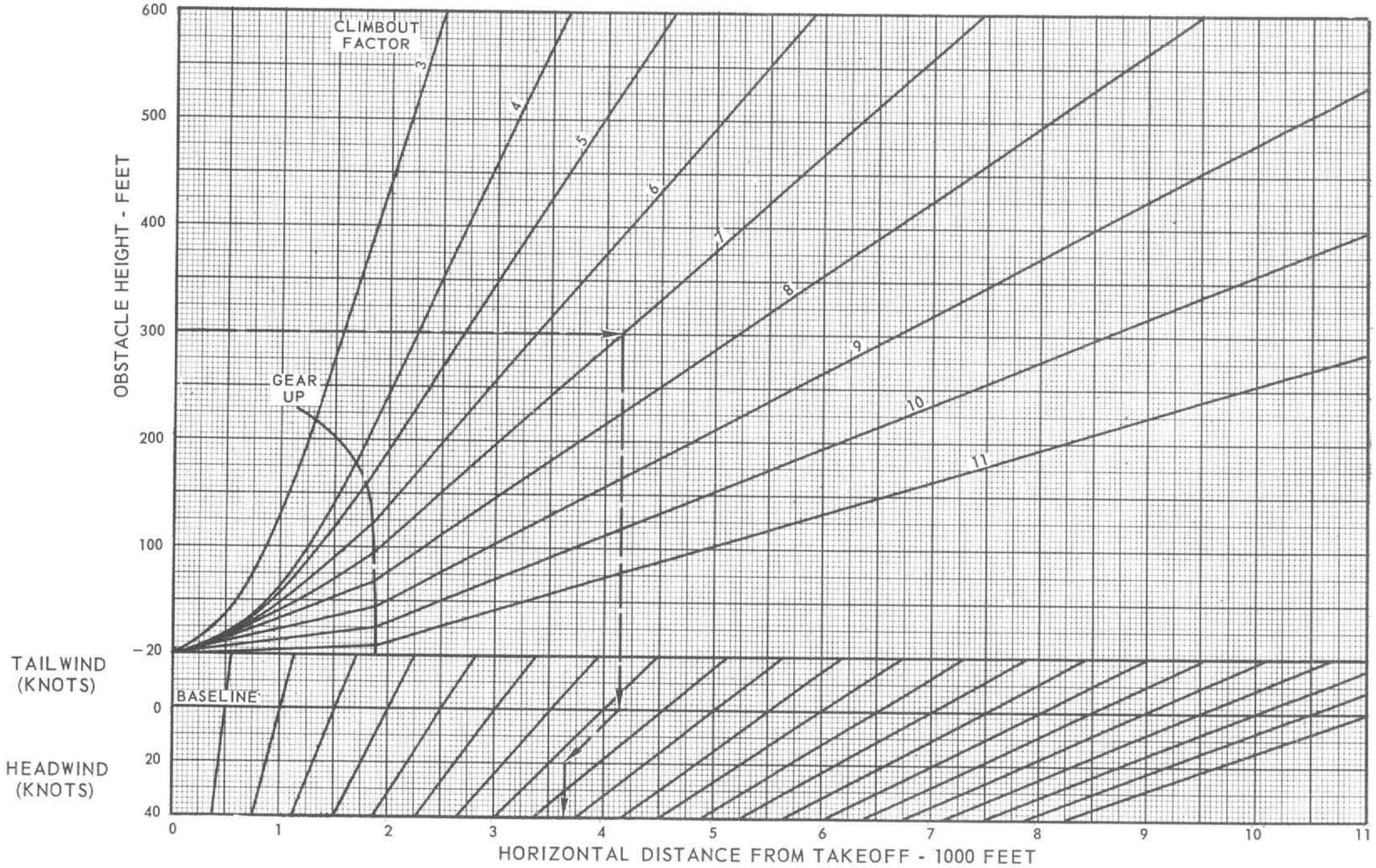
Figure A3-21

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - TWO ENGINES - 0° FLAP

INCLUDING FLARE DISTANCE   OBSTACLE HEIGHT 0-600 FEET   2800 RPM

ENGINES: R2800-99W



NOTES:

(1) LANDING GEAR UP IN 6 SECONDS
(2) CLIMB SPEED = TAKEOFF SPEED
(3) 100% WIND ACCOUNTABILITY

24,181

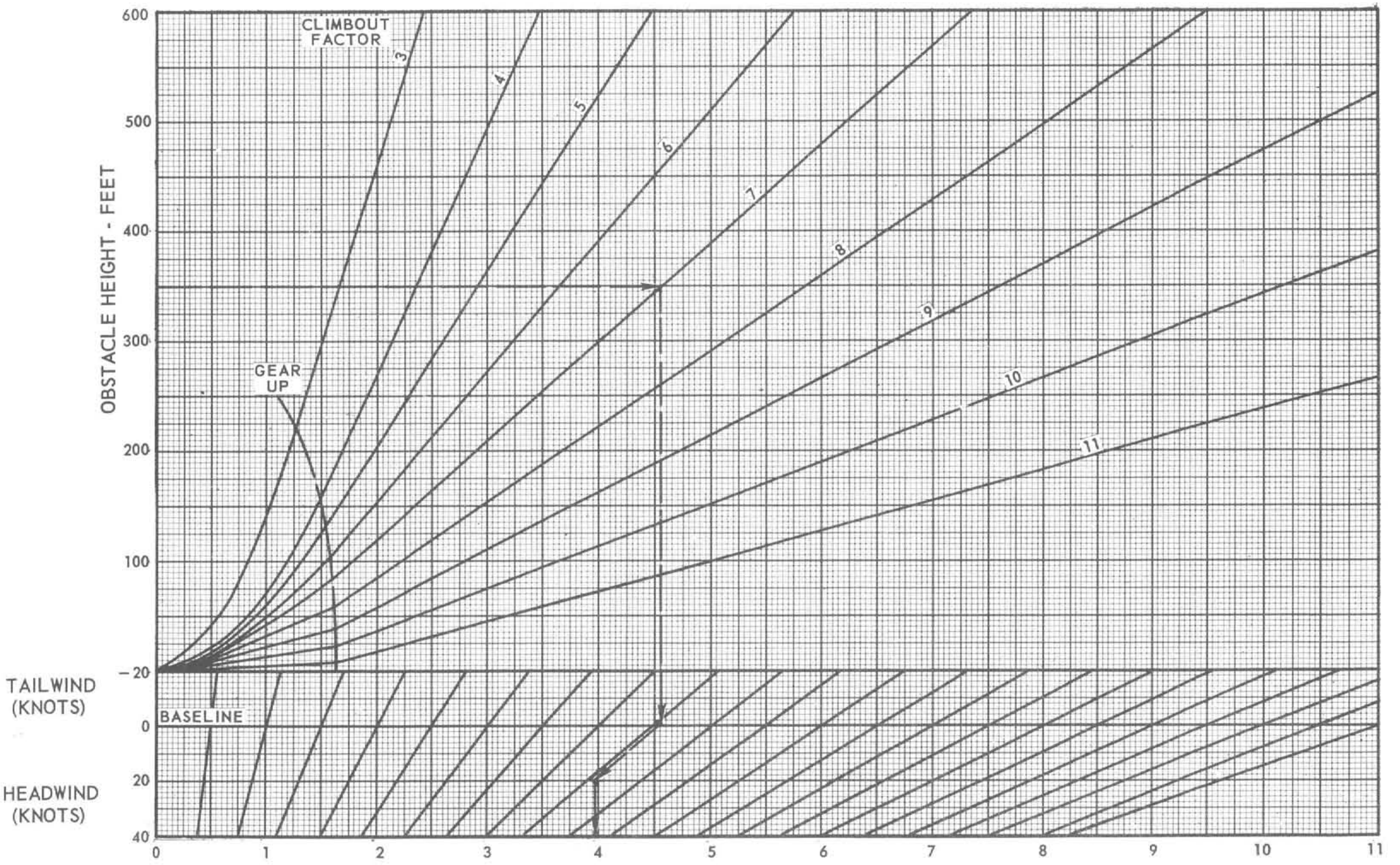
Figure A3-22

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - TWO ENGINES - 6° FLAP

INCLUDING FLARE DISTANCE OBSTACLE HEIGHT 0-600 FEET 2800 RPM

ENGINES: R2800-99W



NOTES:

(1) LANDING GEAR UP IN 6 SECONDS
(2) CLIMB SPEED = TAKEOFF SPEED
(3) 100% WIND ACCOUNTABILITY

24,182

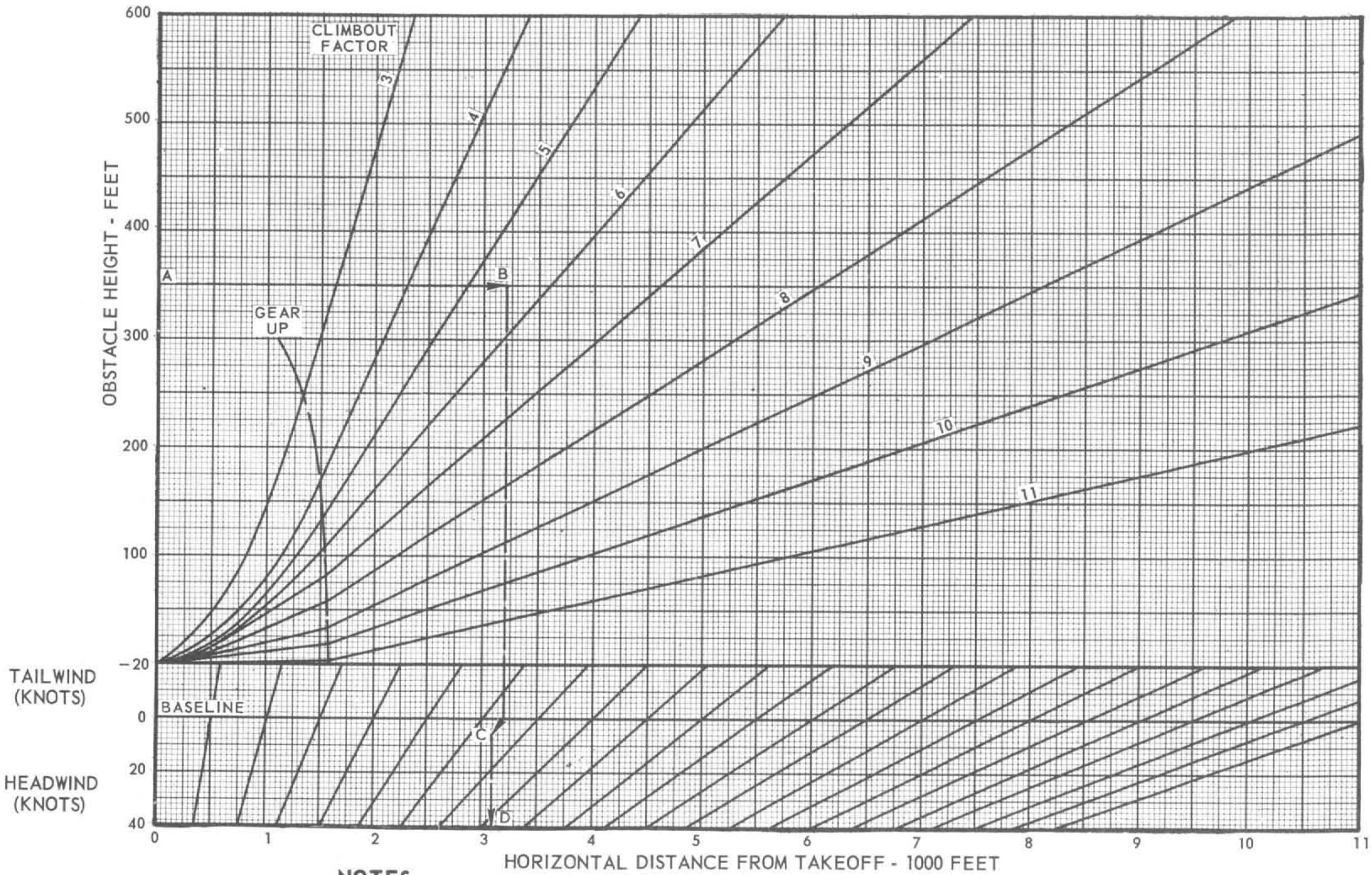
Figure A3-23

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - TWO ENGINES - 12° FLAP

INCLUDING FLARE DISTANCE
OBSTACLE HEIGHT 0 - 600 FEET
2800 RPM

ENGINES: R2800-99W



NOTES:

(1) LANDING GEAR UP IN 6 SECONDS
(2) CLIMB SPEED = TAKEOFF SPEED
(3) 100% WIND ACCOUNTABILITY

24,183

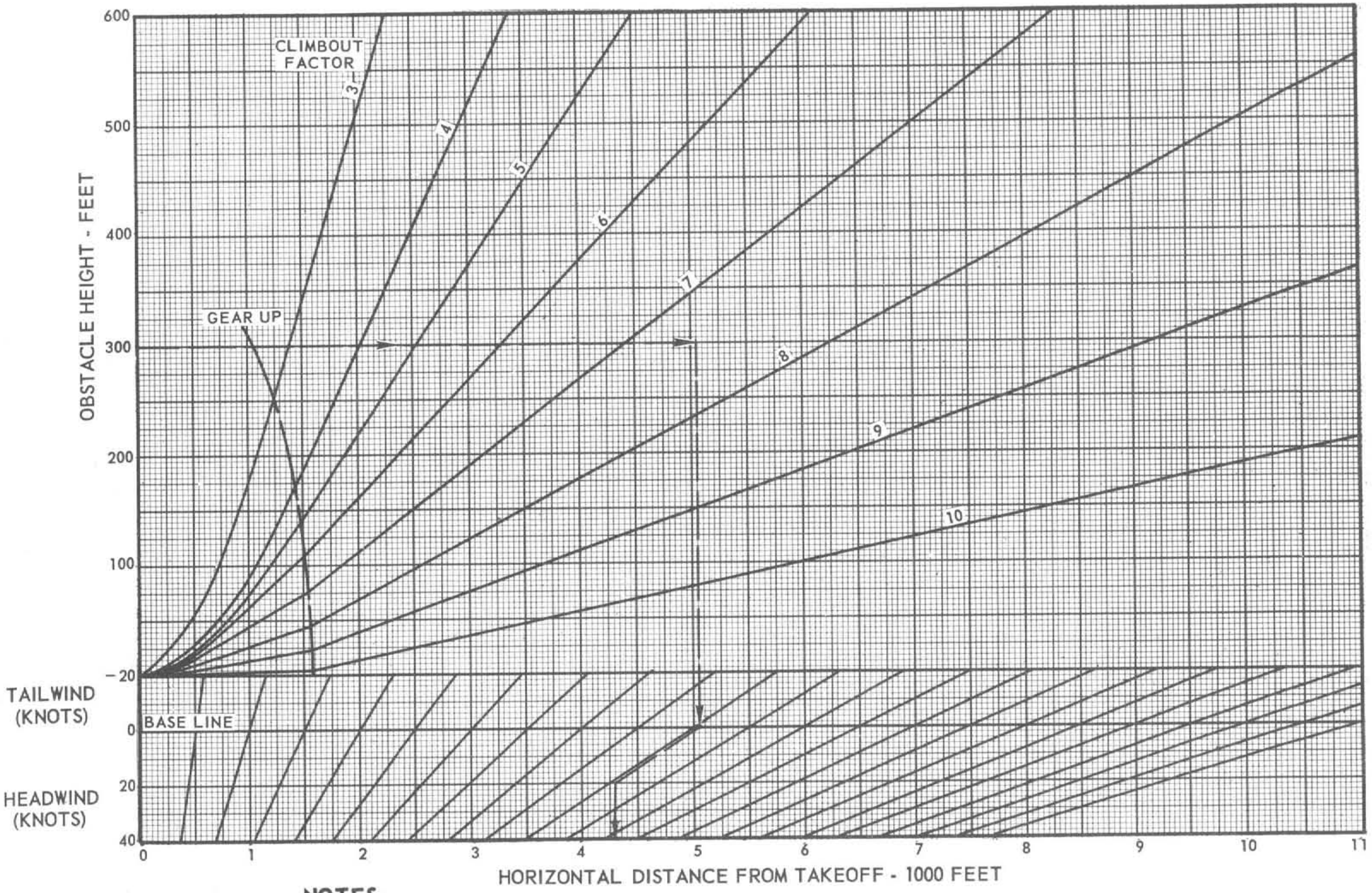
Figure A3-24

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - TWO ENGINES - 24° FLAP

INCLUDING FLARE DISTANCE OBSTACLE HEIGHT 0 - 600 FEET
2800 RPM

ENGINES: R2800-99W



NOTES:

(1) LANDING GEAR UP IN 6 SECONDS
(2) CLIMB SPEED = TAKEOFF SPEED
(3) 100% WIND ACCOUNTABILITY

24,184

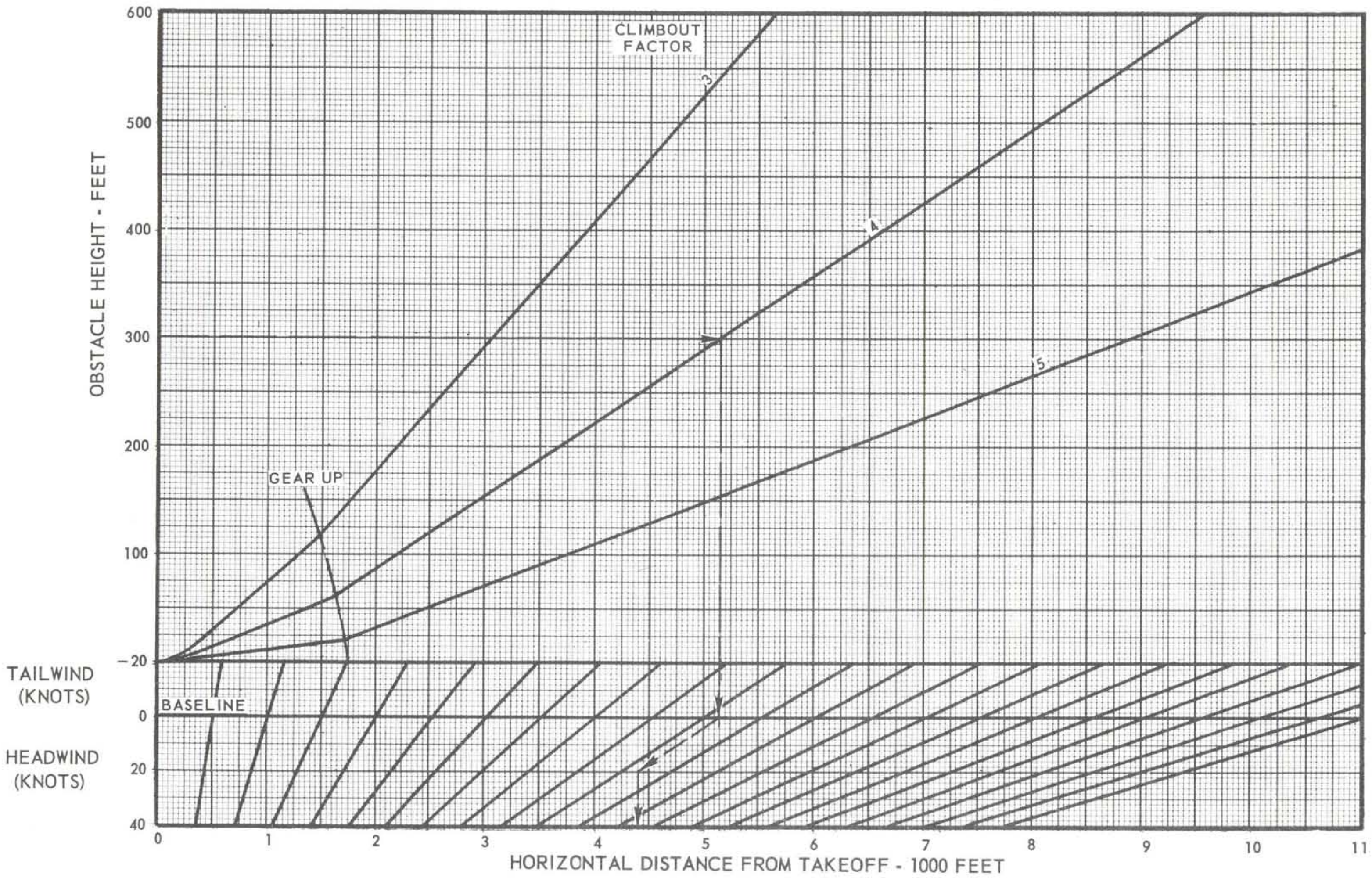
Figure A3-25

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - SINGLE ENGINE - 0° FLAP

INCLUDING FLARE DISTANCE OBSTACLE HEIGHT - 0-600 FEET. 2800 RPM

ENGINES: R2800-99W



NOTES:

(1) INOPERATIVE PROPELLER FEATHERED
(2) LANDING GEAR UP IN 6 SECONDS
(3) CLIMB SPEED = TAKEOFF SPEED
(4) 100% WIND ACCOUNTABILITY

24,185

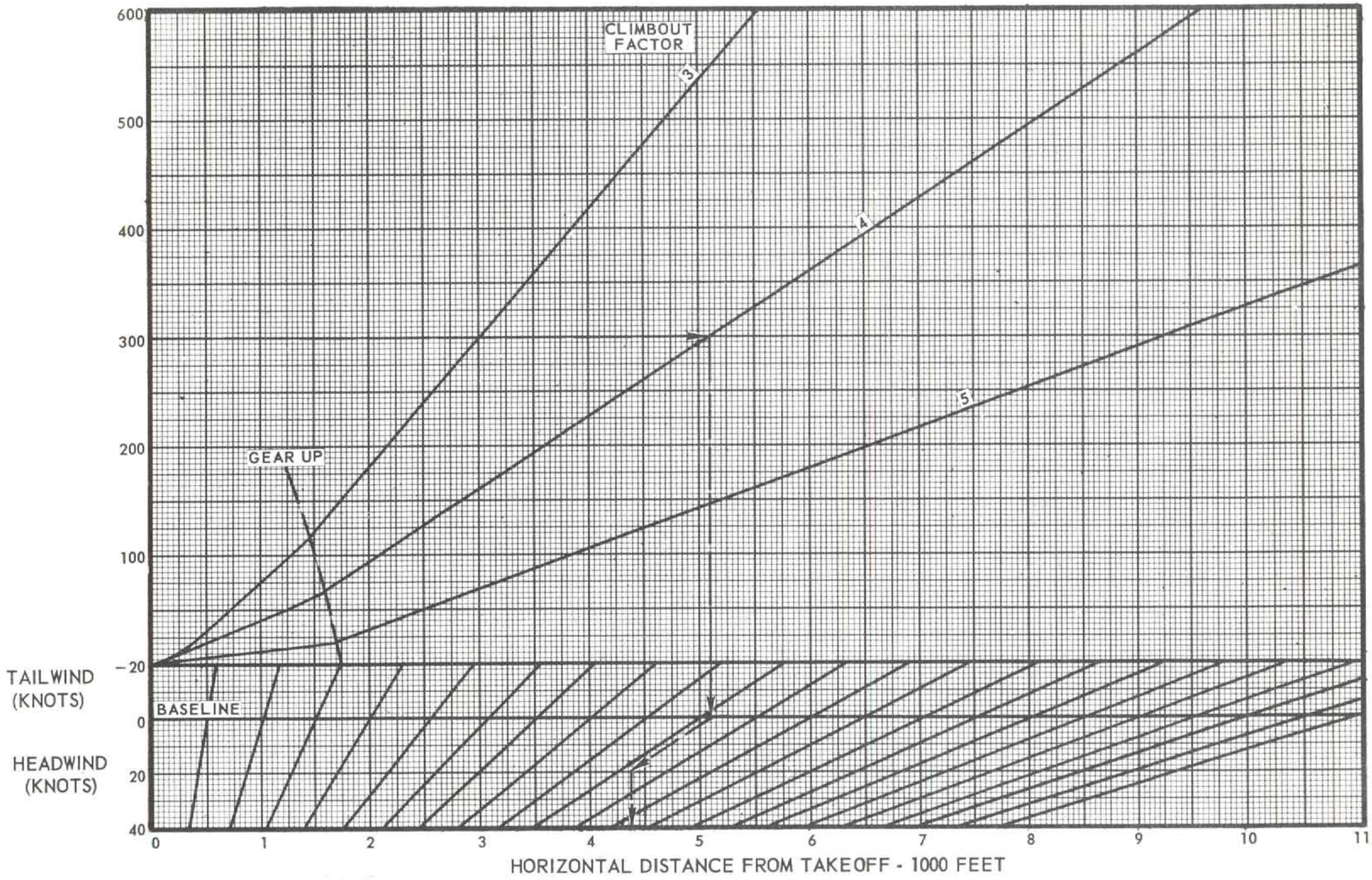
Figure A3-26

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - SINGLE ENGINE - 6° FLAP

INCLUDING FLARE DISTANCE OBSTACLE HEIGHT 0-600 FEET 2800 RPM

ENGINES: R2800-99W



NOTES:

(1) INOPERATIVE PROPELLER FEATHERED
(2) LANDING GEAR UP IN 6 SECONDS
(3) CLIMB SPEED = TAKEOFF SPEED
(4) 100% WIND ACCOUNTABILITY

24,186

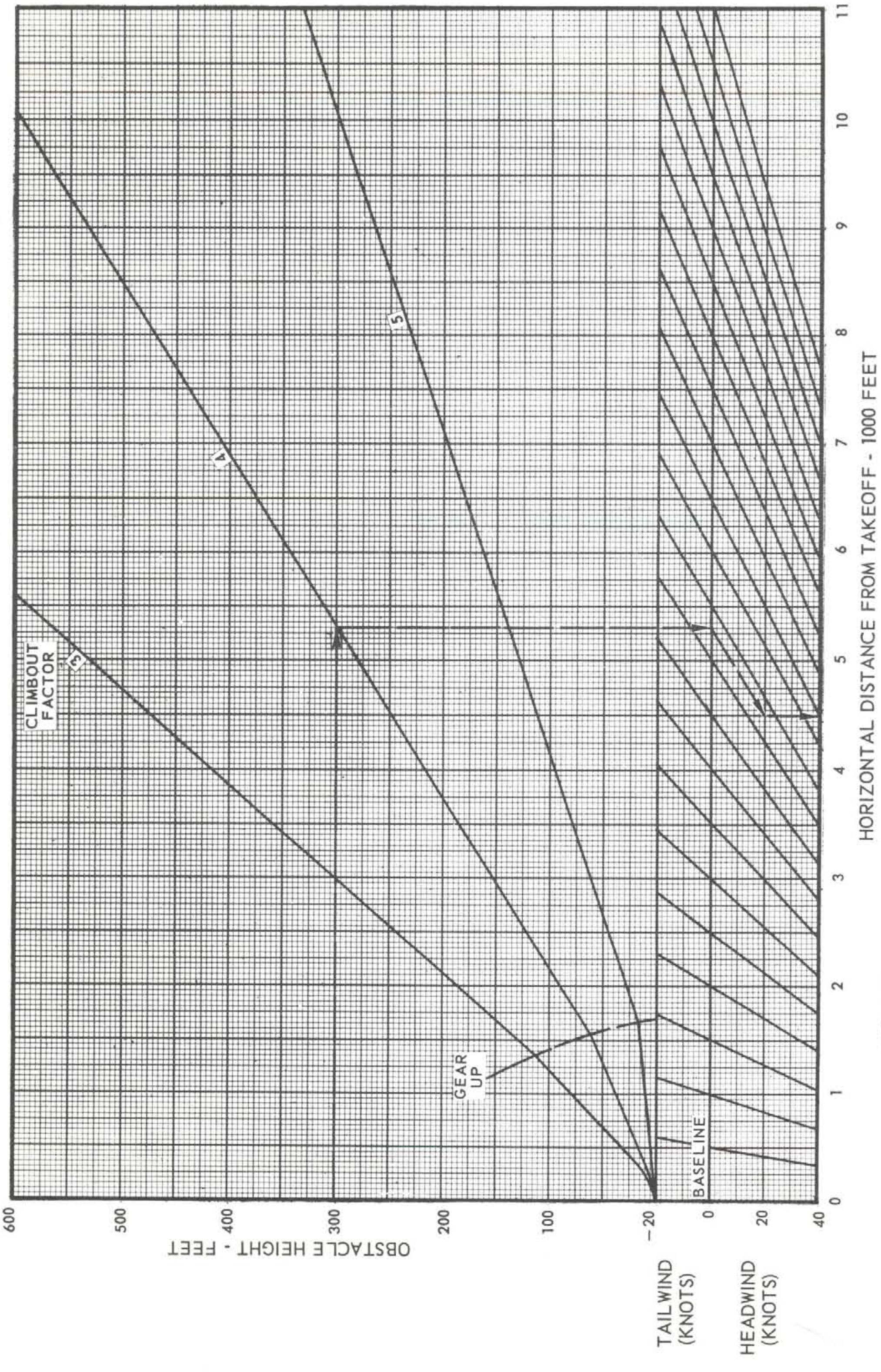
Figure A3-27

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - SINGLE ENGINE - 12° FLAP

INCLUDING FLARE DISTANCE OBSTACLE HEIGHT 0-600 FEET 2800 RPM

ENGINES: R2800-99W



NOTES:

(1) INOPERATIVE PROPELLER FEATHERED
(2) LANDING GEAR UP IN 6 SECONDS
(3) CLIMB SPEED = TAKEOFF SPEED
(4) 100 % WIND ACCOUNTABILITY

24,187

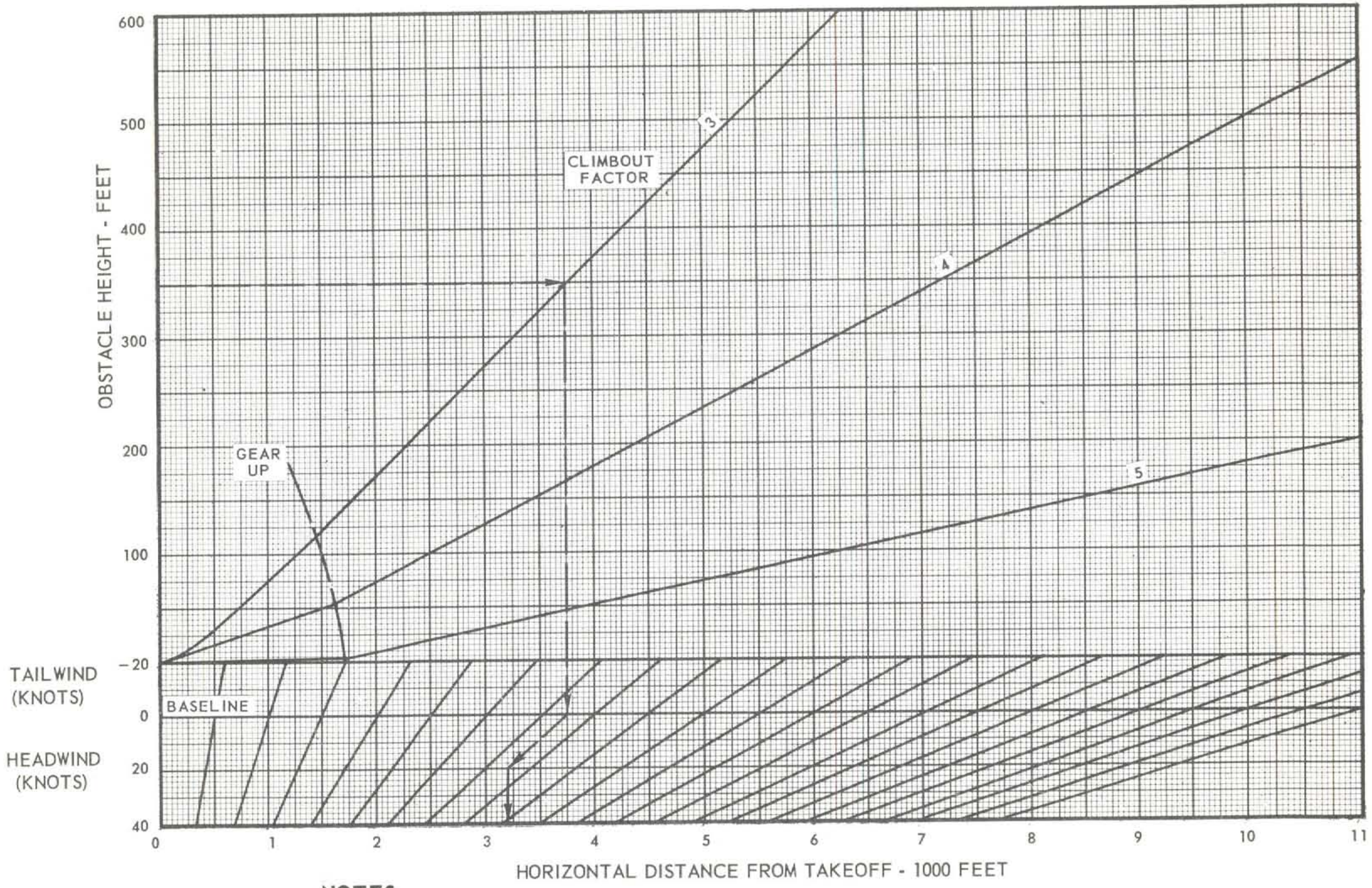
Figure A3-28

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLIMBOUT FLIGHT PATH - SINGLE ENGINE - 24° FLAP

INCLUDING FLARE DISTANCE   OBSTACLE HEIGHT 0-600 FEET   2800 RPM

ENGINES: R2800-99W



NOTES:

(1) INOPERATIVE PROPELLER FEATHERED
(2) LANDING GEAR UP IN 6 SECONDS
(3) CLIMB SPEED = TAKEOFF SPEED
(4) 100% WIND ACCOUNTABILITY

24, 188

Figure A3-29

PART 4—CLIMB

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*The symbol * indicates an illustration*

OPERATIONAL CLIMB

Operational climb performance is presented in two climb curves for normal two-engine operation (figures A4-1 and A4-2). One presents time and speed. The other presents distance and fuel consumed. The data are plotted in a convenient form against weight with guide lines representing the weight variation during a steady climb. The data are based upon climb at 1400 BHP/ENG, 2400 rpm on a standard day with flaps and gear up at a constant airspeed. The climb power schedules show power settings to be used. These include manifold pressure, TPSI and blower speed. Fuel flow is based upon operation in the AUTO RICH mixture position. Climb performance in nonstandard atmospheric conditions is the same as that in standard atmospheric conditions if standard powers are obtainable. It is only necessary to determine the comparable density altitude and obtain the standard power for that altitude.

Note

> The airplane's lift and drag depend primarily upon the density of the air, while the engine power depends upon the pressure of the air, until full throttle is reached. To determine the climb performance under nonstandard conditions, one must determine the fuel, distance and time to climb using density altitudes and obtain the standard power for pressure altitude by adjusting the manifold pressures as required.

If standard powers are not obtainable, a substantial decrease in climb performances can be expected. Speeds shown are those for best rate of climb consistent with engine cooling. Increasing speeds above those shown will decrease the rate of climb and increase time, distance, and fuel consumed in climb. Data are included to show the service (100 fpm rate of climb) and cruise (300 fpm rate of climb) ceilings.

EXAMPLE

For time to climb (figure A4-1) enter chart with gross weight and density altitude at start of climb (A). Parallel guide line to density altitude at end of climb (B). Read across to find time to climb in minutes (C). Gross weight at end of climb may be found by reading across from density altitude at end of climb (B) parallel to fuel lines to fuel used in climb (D) and subtracting this weight from the gross weight at start of climb. For distance and fuel (figure A4-2) follow same procedure as for time to climb and read distance in climb (nautical miles) to the left. Follow guide lines to the right from density altitude at end of climb and read total fuel used in climb.

METO POWER CLIMB

METO power climb performance is presented in two climb curves (figures A4-3 and A4-4). One presents time and speed. The other presents distance and fuel consumed. Airspeeds shown (IAS vs density altitude) are the same for both charts. The data are plotted in a convenient form against weight and guide lines representing the weight variation during a steady climb. The data are based upon climb at METO power (2600 rpm), standard atmosphere with flaps and gear up. The METO power schedule shows power settings to be used. The charts are used in the same manner as the operational climb charts.

SINGLE-ENGINE CLIMB

Single-engine climb performance is presented in figure A4-5. The data are based upon climb at METO power on one engine and the propeller feathered on the other engine at airspeed for best climb. To use the chart, enter the density altitude scale at the desired altitude (A) and proceed horizontally to the airplane gross weight curve (B). Proceed vertically to the torque pressure base line and follow guide lines to desired torque pressure (C), then vertically down to the instantaneous rate of climb scale (D). Enter the best climb speed nomogram with torque pressure (E). Proceed across to the gross weight (F) and then down to the recommended best climb speed (G).

EMERGENCY CLIMB

Single-engine emergency climb performance is presented in figure A4-6. The data are based upon climb at maximum wet power on one engine, the propeller feathered on the other engine, and the landing gear down. Curves for each takeoff flap setting show the airspeed and rate of climb for various gross weights.

CEILING — ONE ENGINE INOPERATIVE

Absolute and service ceilings of the airplane at various weights with METO power under standard conditions are presented in two charts (figures A4-7 and A4-8). One chart is for normal fuel grade 115/145 and the other for alternate grade fuel 100/130. These charts can be used to find terrain clearance if an engine should fail enroute. Single-engine drift-down altitude can also be determined by these charts. The gross weight refers to the gross weight of the airplane at the time of engine failure.

DRIFT-DOWN

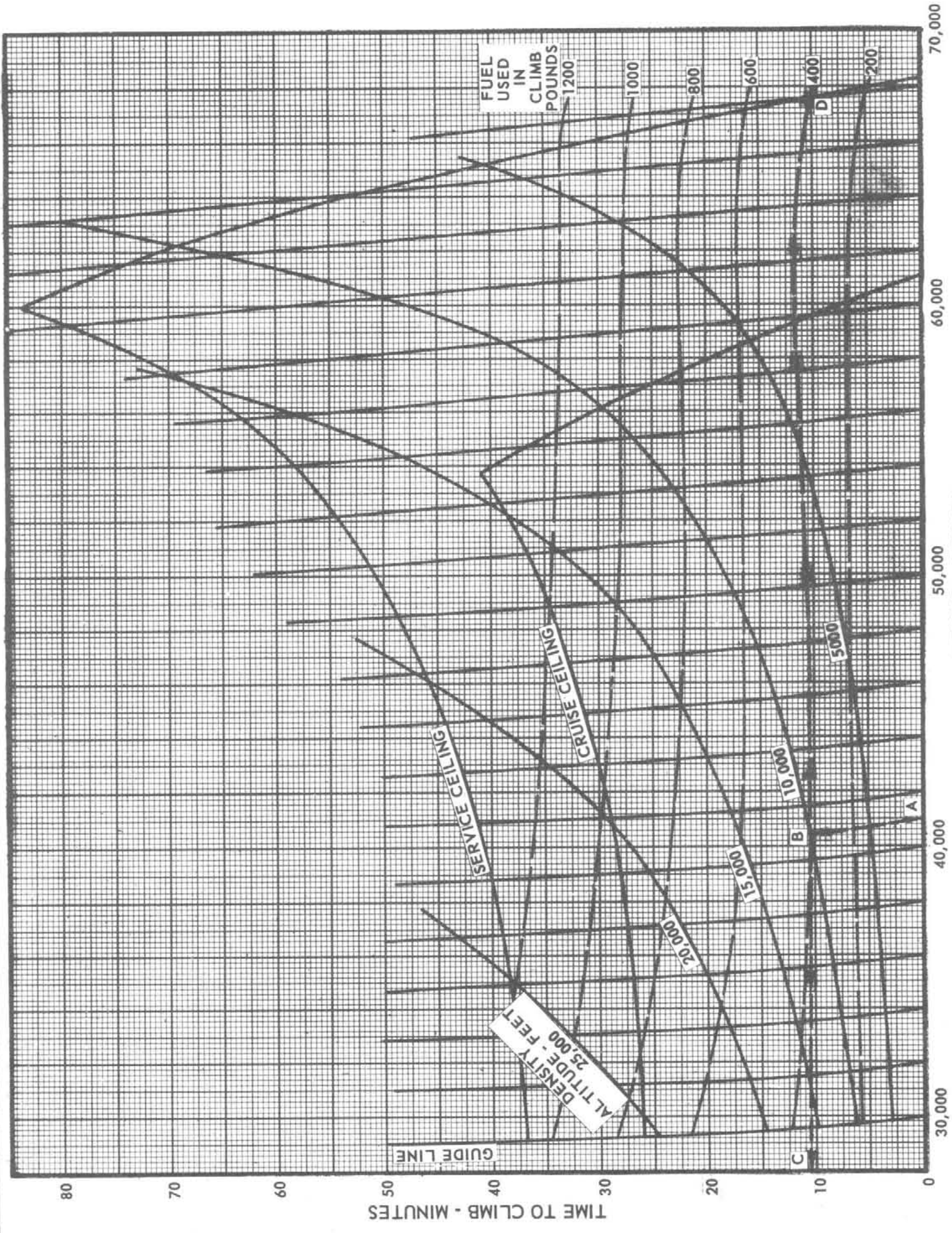
If an engine fails during flight at altitudes above single-engine ceiling, the airplane will drift down; i.e., lose altitude at a decreasing rate until stabilized flight is attained at the absolute ceiling for the power and instantaneous weight conditions. Drift-down performance is presented in figure A4-9. For best results operate the remaining engine at METO power (2600 rpm) and fly the airplane at recommended speeds for weight as shown on chart. In cases of emergency at lower altitudes, the use of military power (2800 rpm) for a limited time will reduce the altitude loss. To use the chart, enter with the airplane gross weight at the time of engine failure (A). Proceed vertically to the initial altitude (B). Read the distance traveled during drift-down on the right-hand scale (C). From the initial altitude, parallel the guide lines down to the gross weight scale (D) and read the airplane gross weight at the end of drift-down (final gross weight). With this weight, enter the final gross weight scale in the upper left corner (E). Proceed vertically down to the drift-down curve, then horizontally to the final altitude scale (F).

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

OPERATIONAL CLIMB - TIME AND SPEED

2400 RPM/1400 BHP

ENGINES: R2800-99W



NOTES:
(1) CLIMB AIRSPEED = 145 KNOTS IAS
(2) AUTO RICH MIXTURE
(3) CLEAN CONFIGURATION

24,230C

Figure A4-1

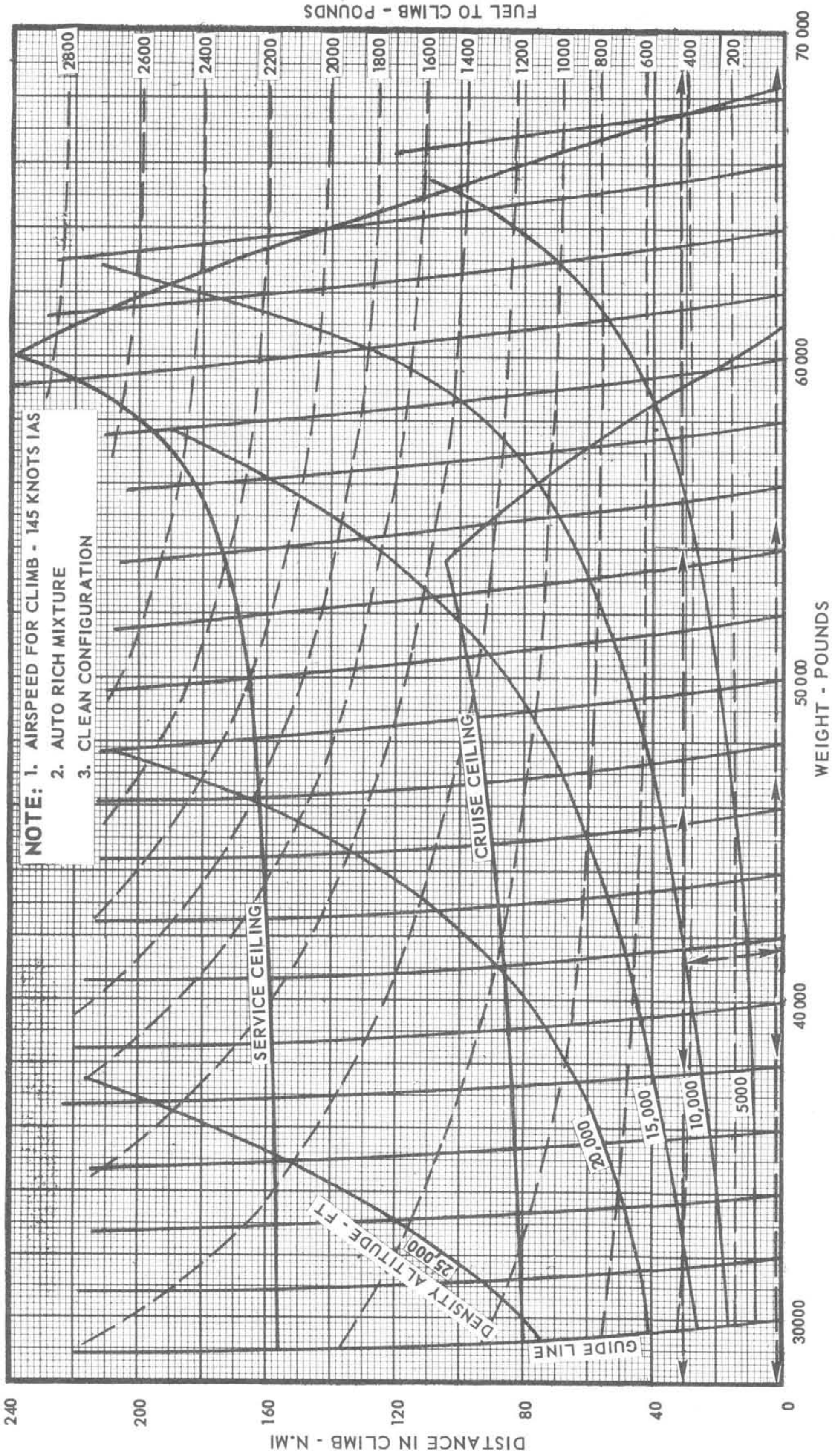
OPERATIONAL CLIMB - DISTANCE AND FUEL

2400 RPM / 1400 BHP

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

ENGINES: R-2800-99W

NOTE: 1. AIRSPEED FOR CLIMB - 145 KNOTS IAS
2. AUTO RICH MIXTURE
3. CLEAN CONFIGURATION



24,231B

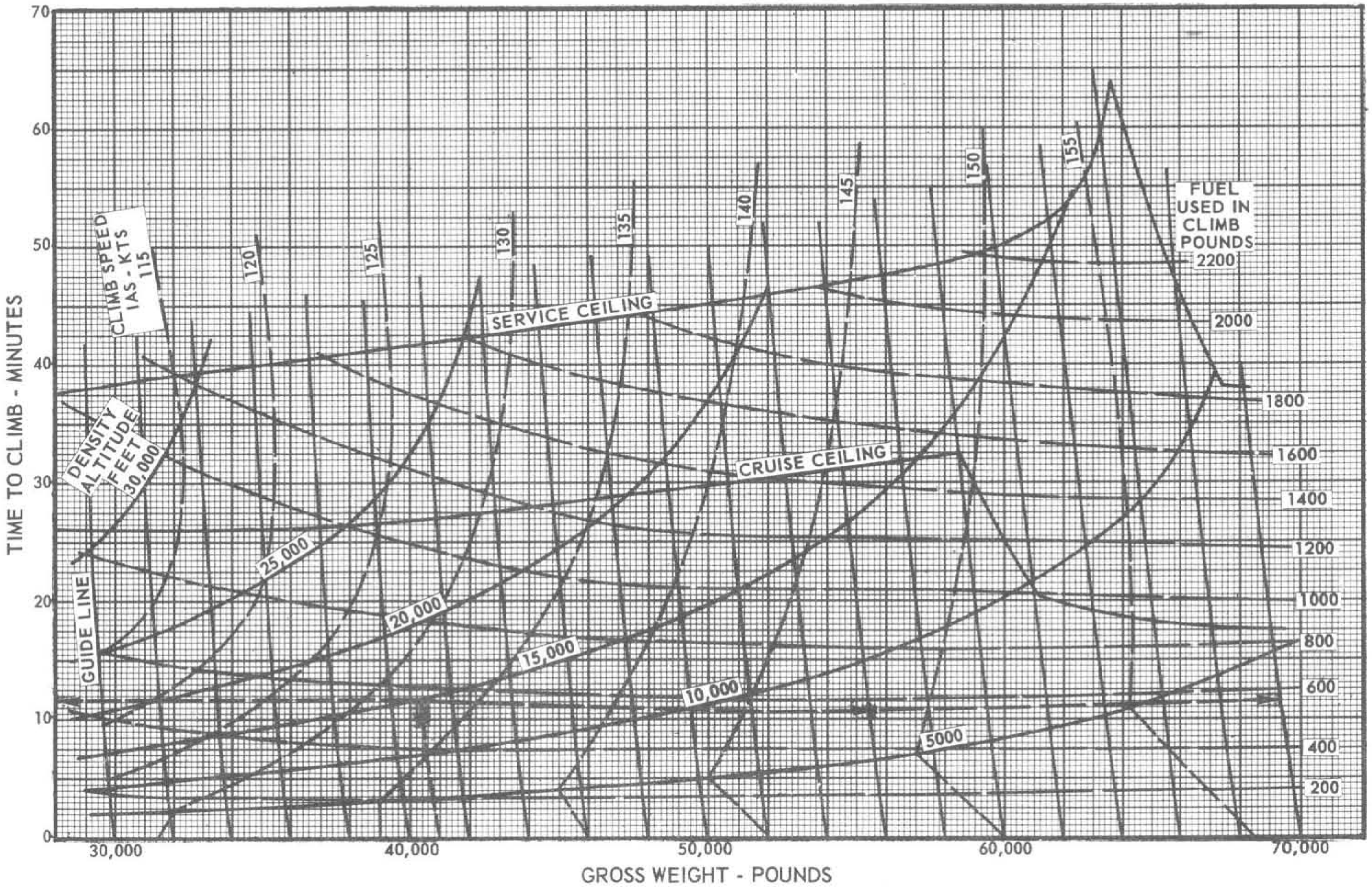
Figure A4-2

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

METO POWER CLIMB - TIME AND SPEED

CLEAN CONFIGURATION FUEL GRADE 115/145

ENGINES: R2800-99W



24, 253C

Figure A4-3

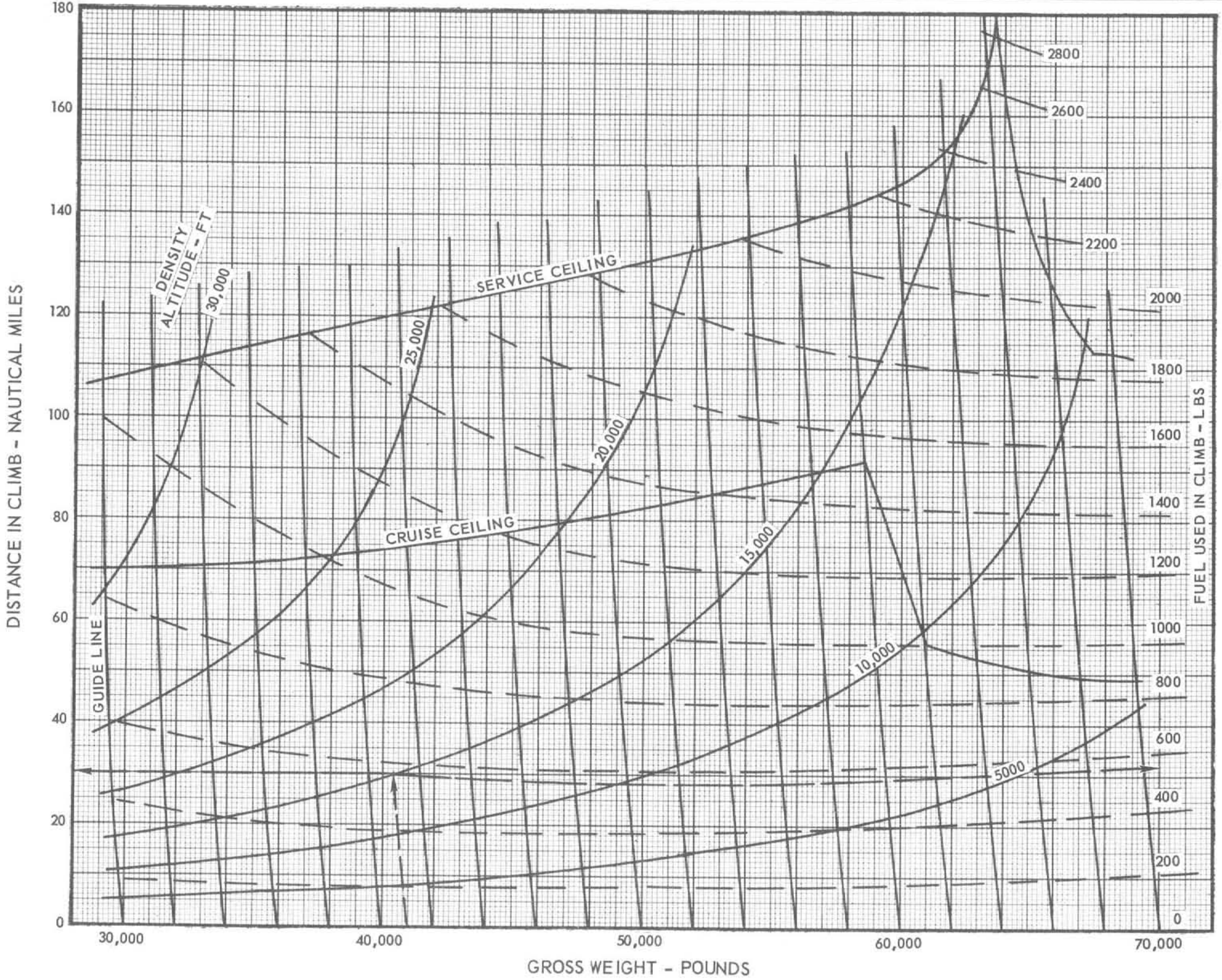
MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

METO POWER CLIMB - DISTANCE AND FUEL

CLEAN CONFIGURATION

FUEL GRADE 115/145

ENGINES: R2800-99W



24,254B

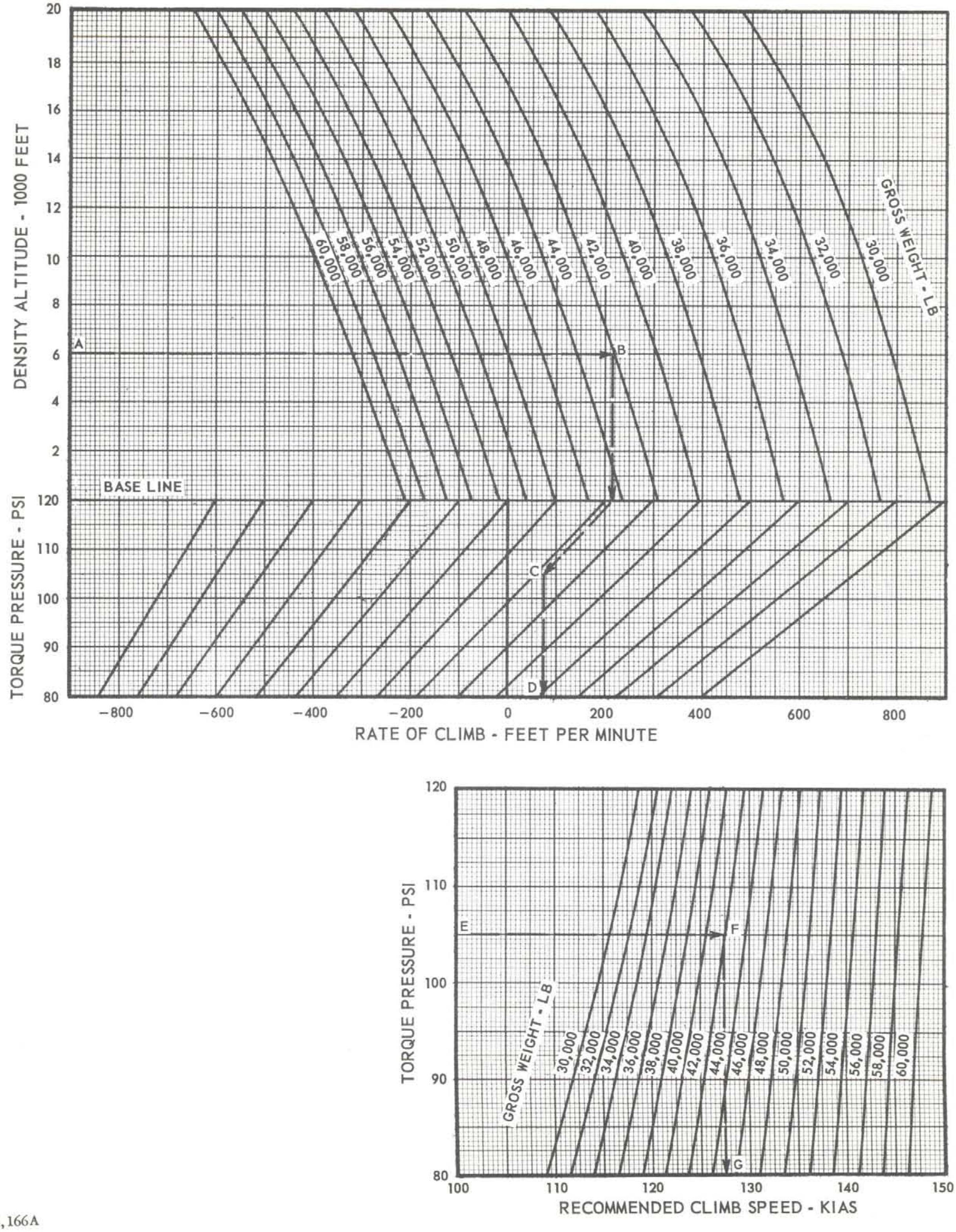
Figure A4-4

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

SINGLE ENGINE CLIMB

2600 RPM AUTO RICH ONE ENGINE INOPERATIVE
PROPELLER FEATHERED
LANDING GEAR AND FLAPS RETRACTED

ENGINES: R2800-99W



24,166A

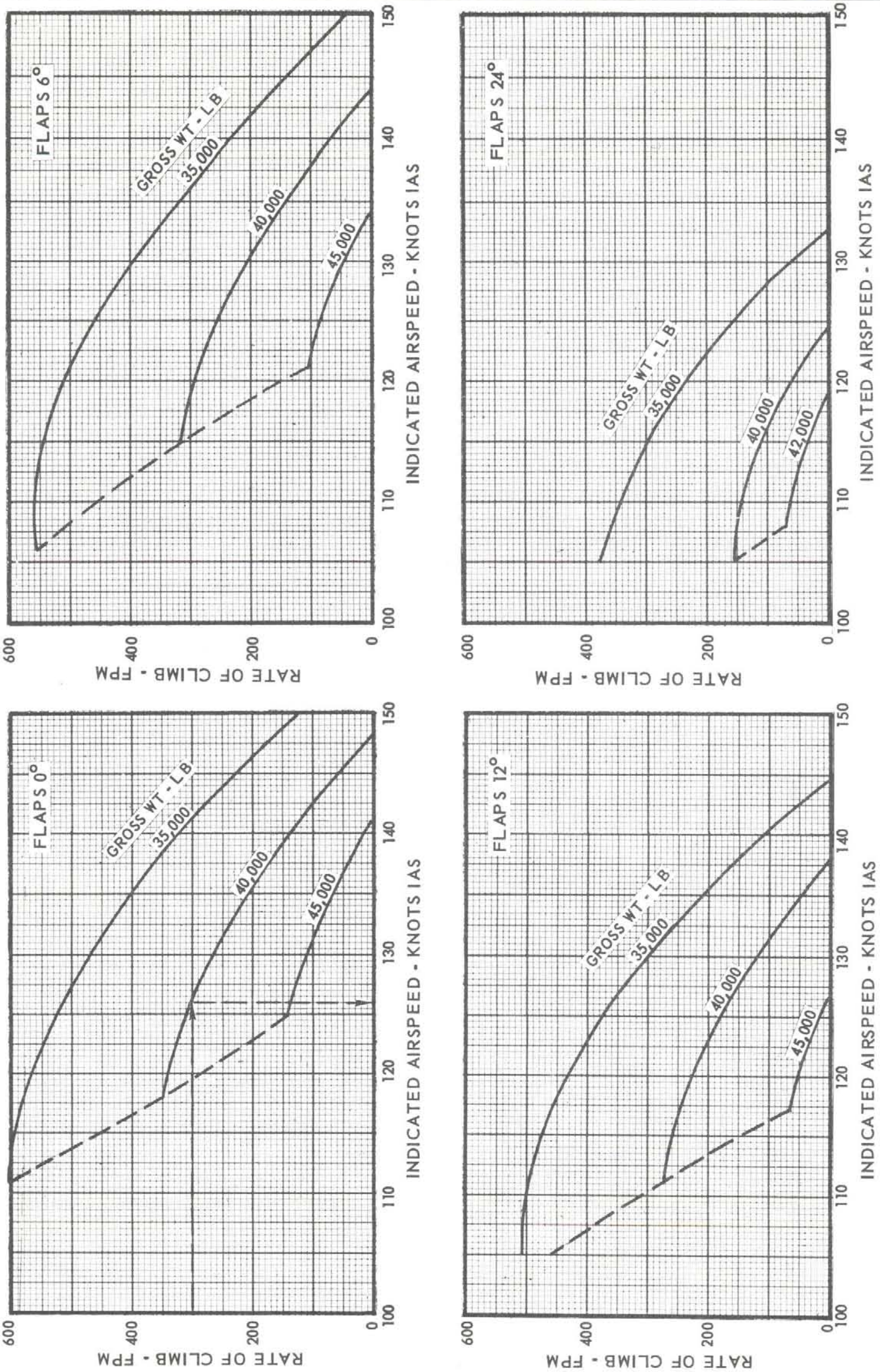
Figure A4-5

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

EMERGENCY CLIMB

ONE ENGINE INOPERATIVE - PROPELLER FEATHERED

LANDING GEAR EXTENDED MAXIMUM WET POWER 115/145 FUEL GRADE ENGINES: R2800-99W



NOTE: — — — — AIRSPEEDS EQUAL TO TAKEOFF SPEED

24,241B

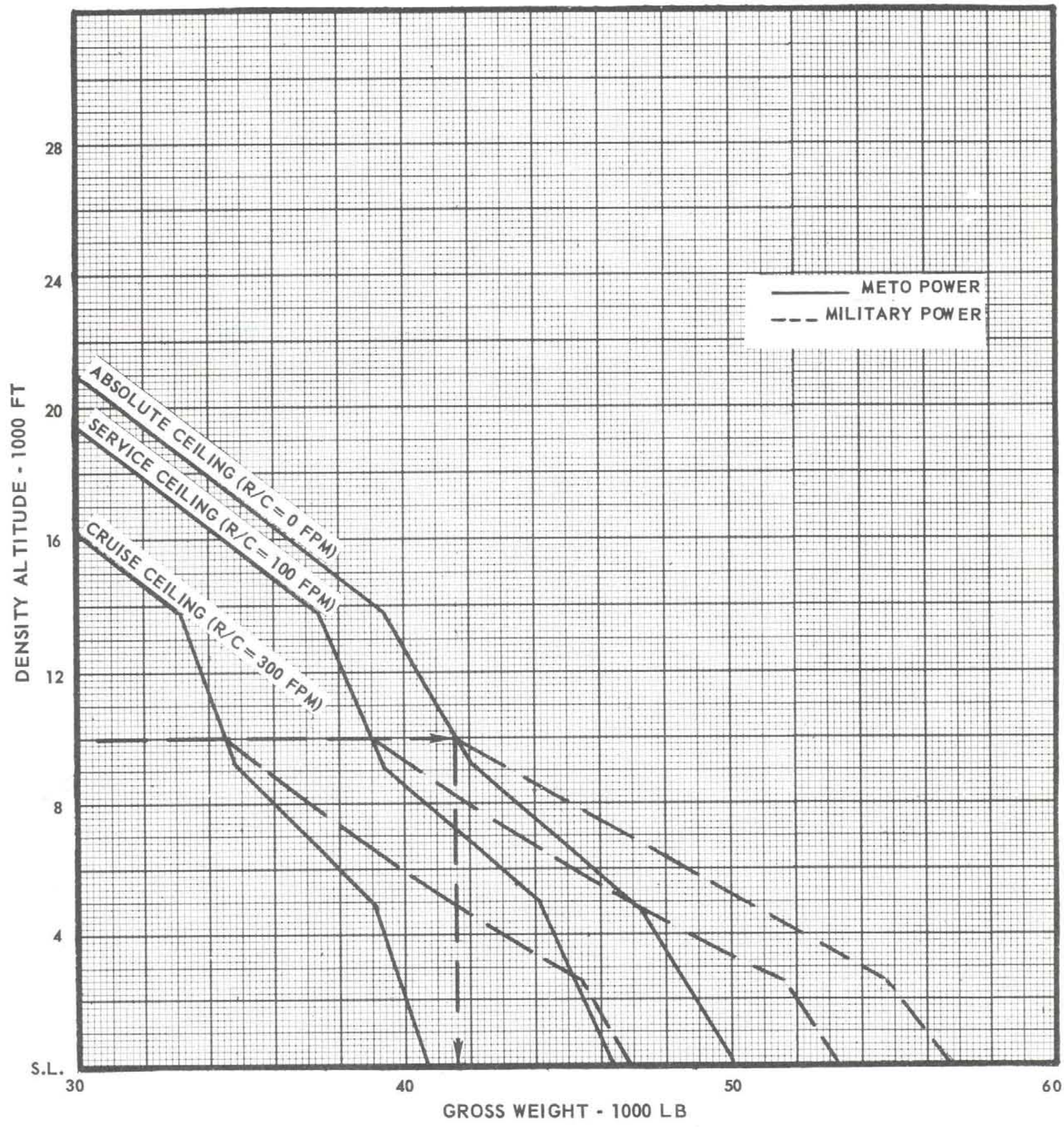
Figure A4-6

CEILING - ONE ENGINE INOPERATIVE

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

FUEL GRADE 115/145 CLEAN CONFIGURATION
PROPELLER FEATHERED

ENGINES: R-2800-99W



24,242A

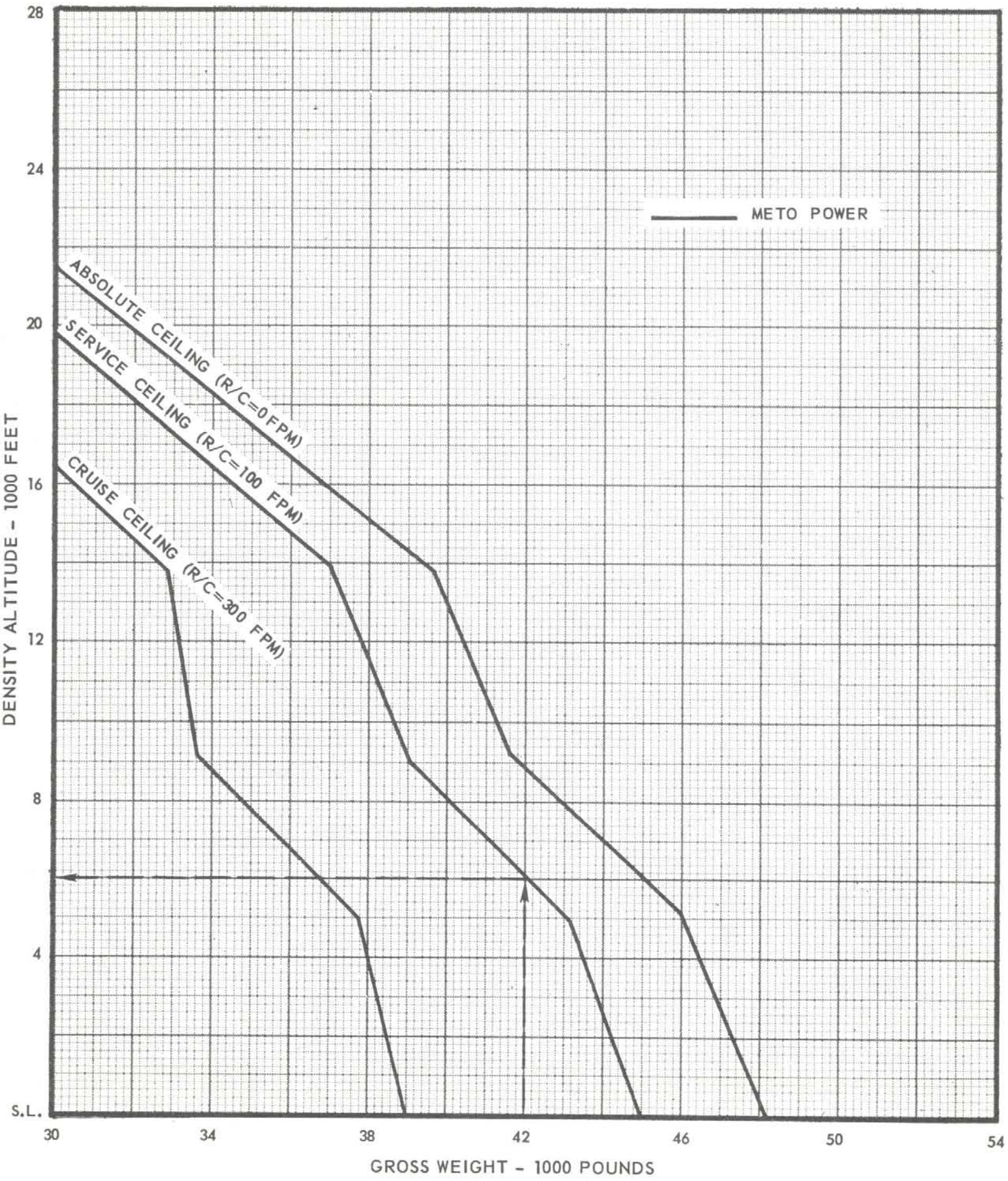
Figure A4-7

CEILING - ONE ENGINE INOPERATIVE

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

FUEL GRADE 100/130 CLEAN CONFIGURATION
PROPELLER FEATHERED

ENGINES: R-2800-99W



24,243B

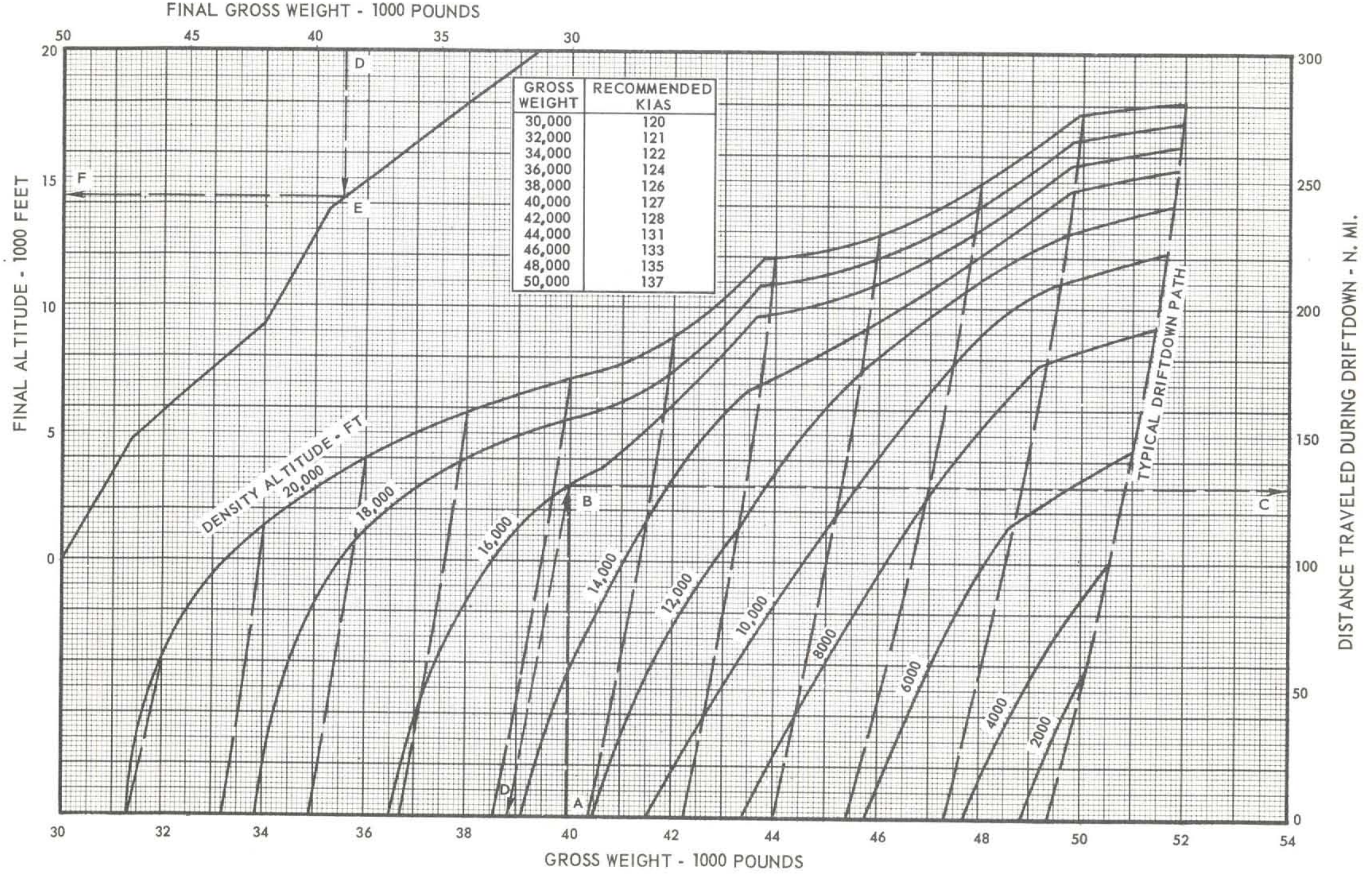
Figure A4-8

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

DRIFTDOWN - ONE ENGINE INOPERATIVE

METO POWER

ENGINES: R2800-99W



GROSS WEIGHT	RECOMMENDED KIAS
30,000	120
32,000	121
34,000	122
36,000	124
38,000	126
40,000	127
42,000	128
44,000	131
46,000	133
48,000	135
50,000	137

24,167

Figure A4-9

PART 5 — CRUISE

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*The symbol * indicates an illustration*

CRUISE CONTROL

Cruise performance as used in this Appendix is defined as being that portion of flight wherein the altitude is held constant, i.e., level flight. The speeds and powers used are selected to maintain this condition. Data are shown to determine this relationship between speed and power throughout the usable range of the airplane. Power is shown as BHP per engine. Reference to the power schedules will show the necessary power settings of MAP, TPSI and rpm to deliver this BHP per engine.

NAUTICAL MILES PER POUND OF FUEL

Nautical miles per pound of fuel curves (figures A5-1 through A5-5) are presented for several density altitudes from sea level to the maximum usable altitude of the airplane in increments of 5000 feet. The data are based upon fuel flow expected when mixture controls are adjusted manually to desired fuel flow and by use of manual leaning procedures as specified in Section VII. The nautical miles per pound of fuel curves are applicable in any nonstandard conditions where the powers shown may be obtained. To simplify selections of speed and power for long range cruising, three curves are shown to represent the powers and speeds to be selected for flight in wind conditions for 50-knot tailwind, zero wind and 50-knot headwind. Wind conditions between these lines can be interpolated. The following examples show the various methods of using these charts.

EXAMPLE 1. Determine power and speed for long range cruise.

Given:

Density altitude = 10,000 feet
Gross weight at start of cruise = 42,000 pounds
Gross weight at end of cruise = 38,000 pounds

Enter chart (figure A5-3) at weight at start of cruise 42,000 pounds. Follow weight line to intersection of long range line (no wind) and find 1000 bhp at start of cruise. Proceed vertically to calibrated airspeed of 167 knots at start of cruise. Repeat the procedure with gross weight at end of cruise to find 925 bhp and 165 knots CAS at end of cruise.

Note

> This cruise procedure requires changes in power and airspeed to maintain long range conditions. An alternate method would be to use an average gross weight for cruise and fly at a constant power and airspeed for that weight.

EXAMPLE 2. Determine distance, fuel used, and airspeed for two-hour cruise at 1000 bhp.

Note

> Since it is desired to cruise at 1000 bhp for two hours, a sufficiently accurate estimate may be made of the fuel flow by reading nautical miles per pound of fuel value and a true airspeed value at an assumed average weight and dividing the true airspeed by the air nautical miles per pound of fuel (n mi/hr÷n mi/lb=lb/hr).

Using same altitude and weight as Example 1 and assuming a fuel flow of 900 pounds per hour, then average weight for two-hour cruise is 42,000−900=41,100 pounds. Enter chart (figure A5-3) at average cruise weight and follow weight lines to intersection of 1000 bhp. Proceed vertically to find TAS of 195 knots. Proceed horizontally from weight and power intersection to find 0.232 air nautical miles per pound. Then fuel used is 195÷0.232=845 pounds per hour.

Note

> The fuel used figure of 845 pounds is close enough to the assumed value of 900 pounds. If it were substantially different, another estimate should be made.

Weight at end of two-hour cruise is 42,000 −1690= 40,310 pounds. Distance in two-hour cruise is 195 knots × 2 hours=390 nautical miles.

EXAMPLE 3. Interpolation for intermediate altitudes.

Given:

Density altitude=13,000 feet
Gross weight at start of cruise=42,000 pounds

Power and speed for long range cruise at 13,000 feet can be determined by interpolation between 10,000 feet and 15,000 feet. In Example 1, the power and speed for 42,000 pounds and 10,000 feet were found to be 1000 bhp and 167 knots CAS. Using the same procedure with the chart for 15,000 feet (figure A5-4), the power and speed are found to be 1050 bhp and 165 knots CAS. The difference between 1000 bhp and 1050 bhp is 50 bhp for 5000 feet difference in altitude. Find the difference in BHP for 3000 feet by the following ratio:

$$\frac{\text{BHP}}{50} = \frac{3}{5}$$

$$\text{BHP} = \frac{3 \times 50}{5} = 30$$

Then BHP for 13,000 feet is 1000+30=1030 bhp. Note that the difference in calibrated airspeed is negligible.

MAXIMUM ENDURANCE

Data from the nautical miles per pound of fuel curves have been replotted in the Maximum Endurance Chart (figure A5-6) for convenient determination of recommended minimum power and speed. The data show BHP/ENG, speed, and resulting fuel flow for gross weight and density altitude.

LONG RANGE PREDICTION

The long range prediction curves (figures A5-7 and A5-8) present the distance and time as fuel is used during cruise.

EXAMPLE

Given:

Weight at start of cruise=41,600 pounds
Density altitude=10,000 feet
Cruise distance=902 nautical miles

Enter chart (figure A5-7) at gross weight 41,600 pounds (A) and read up to density altitude 10,000 feet (B). Read across to distance and read 2850 nautical miles (C). Add the cruise distance (2850+902=3752) and re-enter chart at 3752 nautical miles (D). Read across to 10,000 feet density altitude (E) and down to find gross weight at end of cruise 38,000 pounds (F). The difference between the weight at start of cruise and the weight at end of cruise (41,600−38,000=3600) is the weight of fuel used for 902 nautical miles cruise at CAS for long range. CAS is obtained from the applicable nautical miles per pound of fuel chart. Determination of time for cruise is done by the same procedure with the long range prediction time curve (figure A5-8).

Note

> These charts can also be used to find the distance traveled and the elapsed time for any given amount of fuel used. Enter the chart at the gross weight at start of cruise and at end of cruise. Extend lines from these two points up to the density altitude line, then across to the distance (or time) at altitude scale. The difference between the two points of distance (or time) is the distance traveled or elapsed time.

CRUISE CONTROL — ONE ENGINE INOPERATIVE

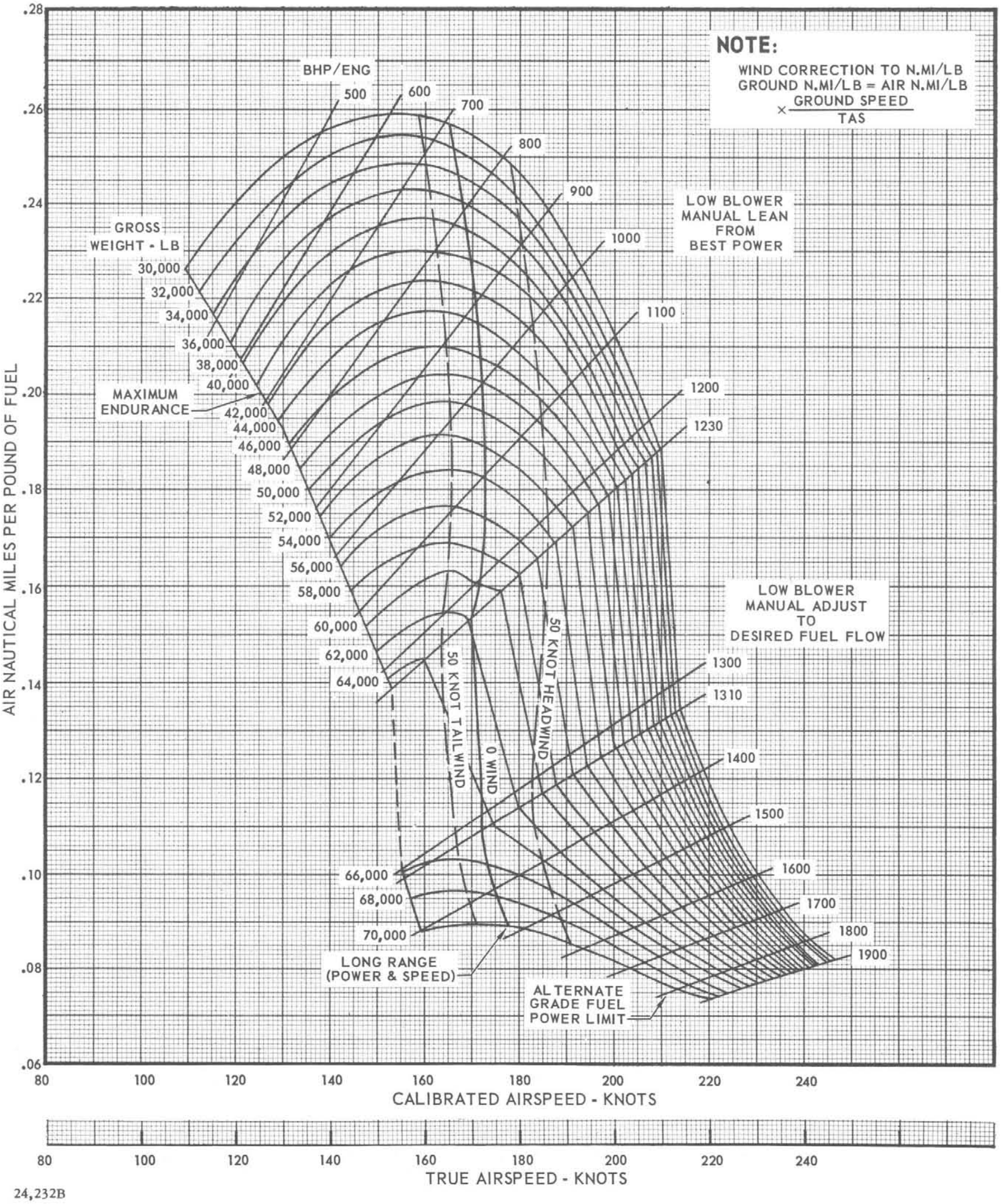
Nautical miles per pound of fuel data similar to that presented for normal cruise is presented for cruise with one engine inoperative, propeller feathered (figures A5-9 through A5-12). It is important that the propeller be feathered; if it is allowed to windmill, a serious reduction in range will result.

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

NAUTICAL MILES PER POUND OF FUEL - SEA LEVEL

TWO ENGINE CRUISE STANDARD ATMOSPHERE

ENGINES: R2800-99W



24,232B

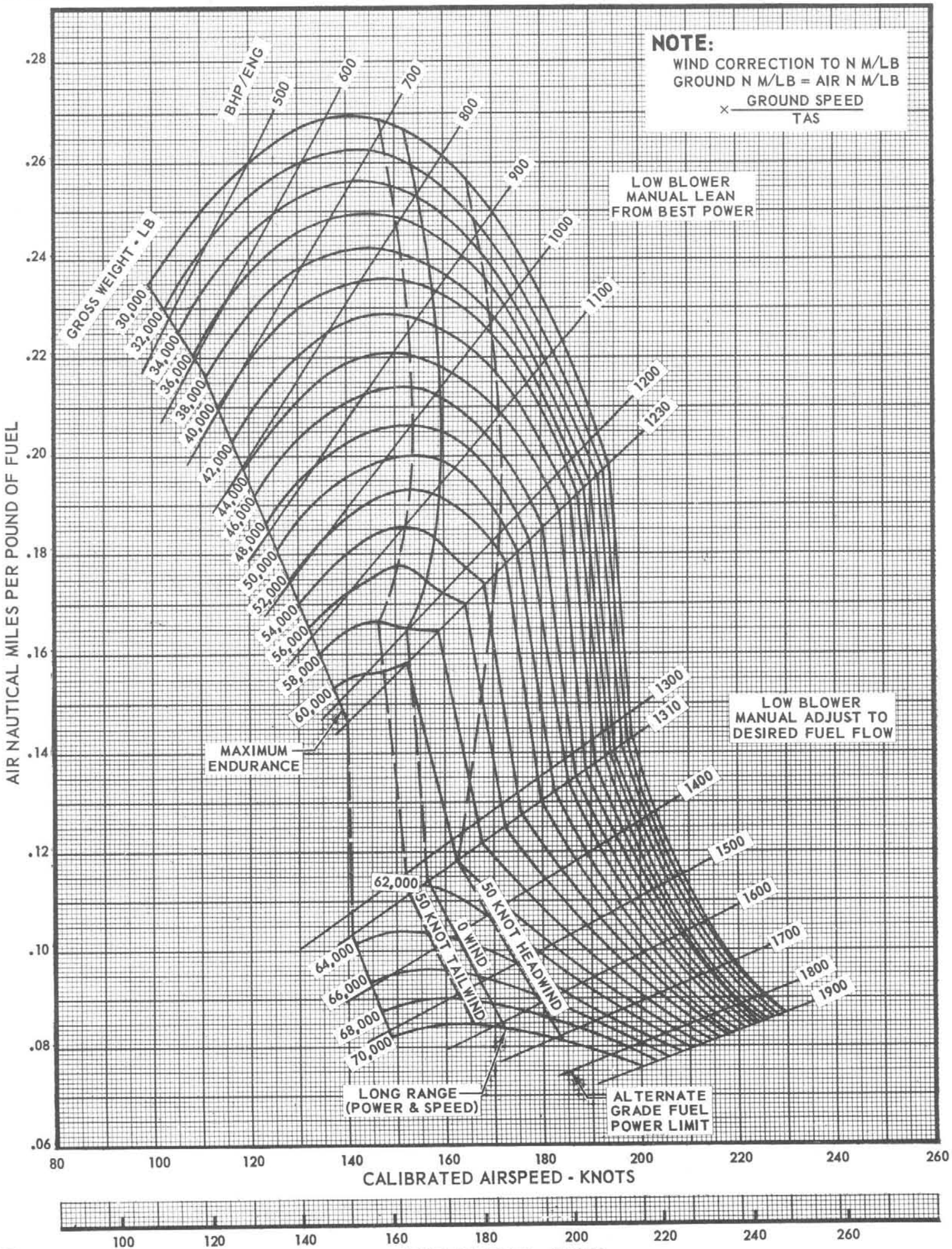
Figure A5-1

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

NAUTICAL MILES PER POUND OF FUEL - 5000 FEET

TWO ENGINE CRUISE   STANDARD ATMOSPHERE

ENGINES: R2800-99W



24,233B

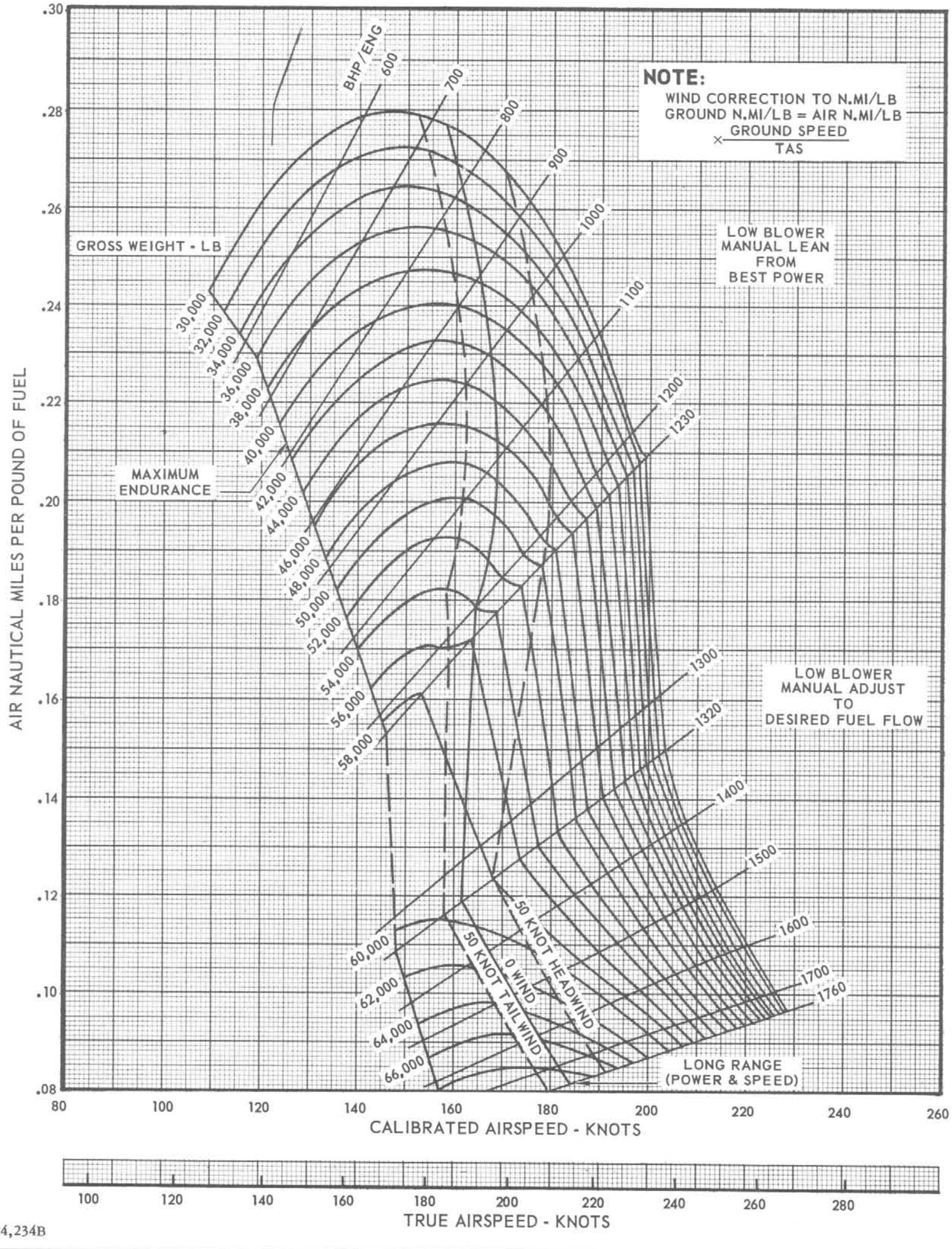
Figure A5-2

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

NAUTICAL MILES PER POUND OF FUEL - 10,000 FEET

TWO ENGINE CRUISE STANDARD ATMOSPHERE

ENGINES: R2800-99W



24,234B

Figure A5-3

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

NAUTICAL MILES PER POUND OF FUEL - 15,000 FEET

TWO ENGINE CRUISE STANDARD ATMOSPHERE

ENGINES: R2800-99W

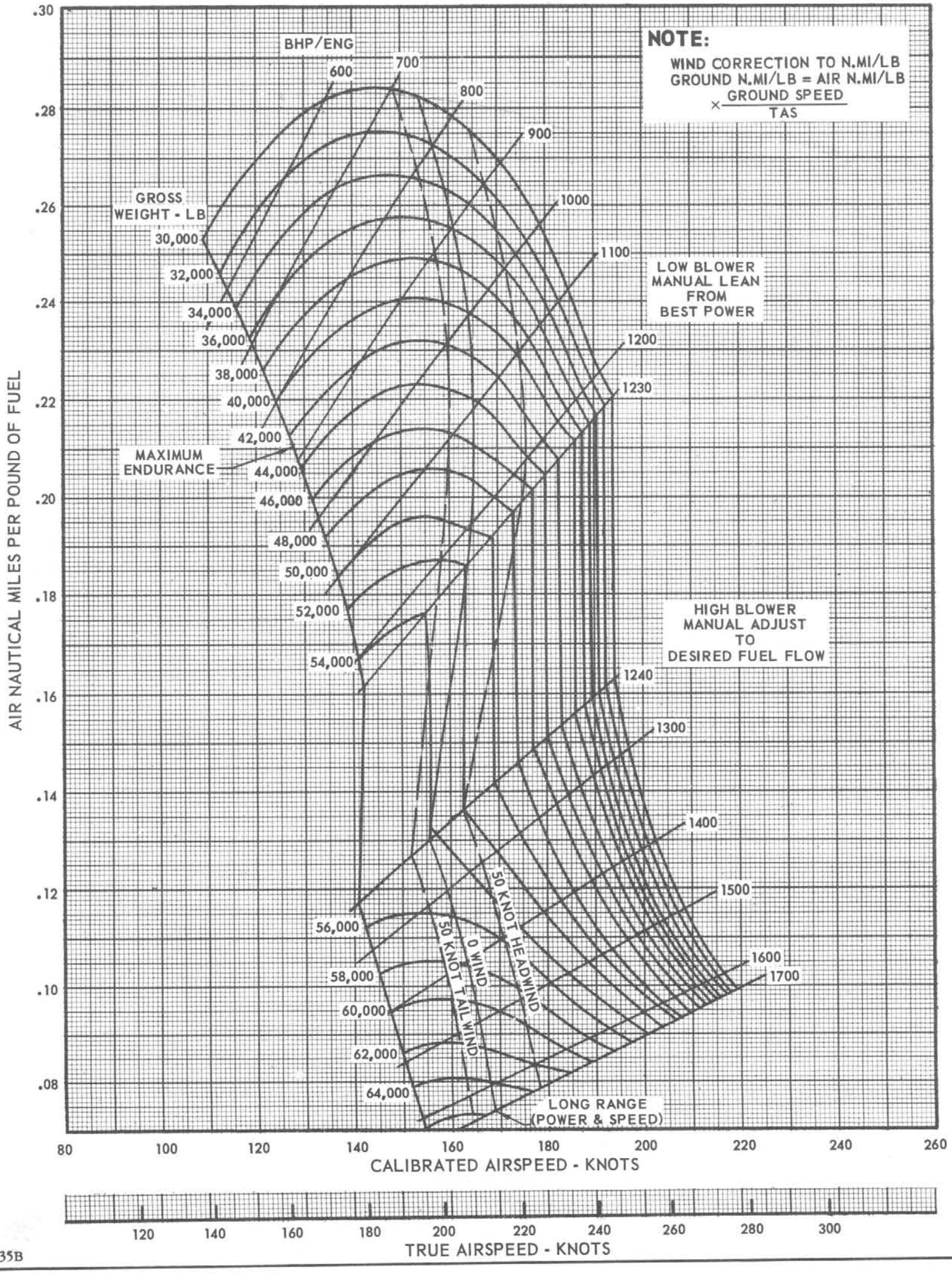


Figure A5-4

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

NAUTICAL MILES PER POUND OF FUEL - 20,000 FEET

TWO ENGINE CRUISE STANDARD ATMOSPHERE

ENGINES: R2800-99W

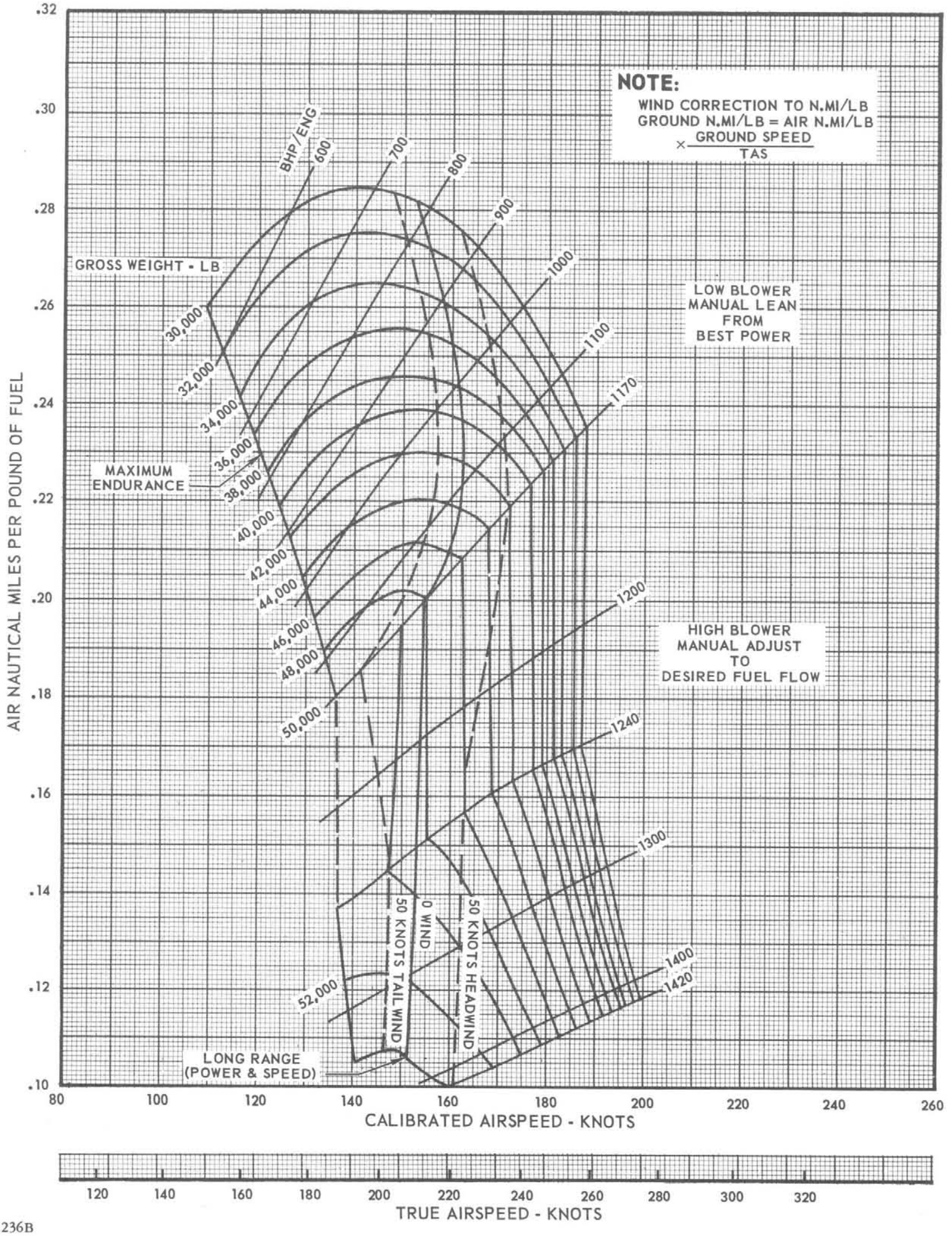


Figure A5-5

MAXIMUM ENDURANCE SUMMARY

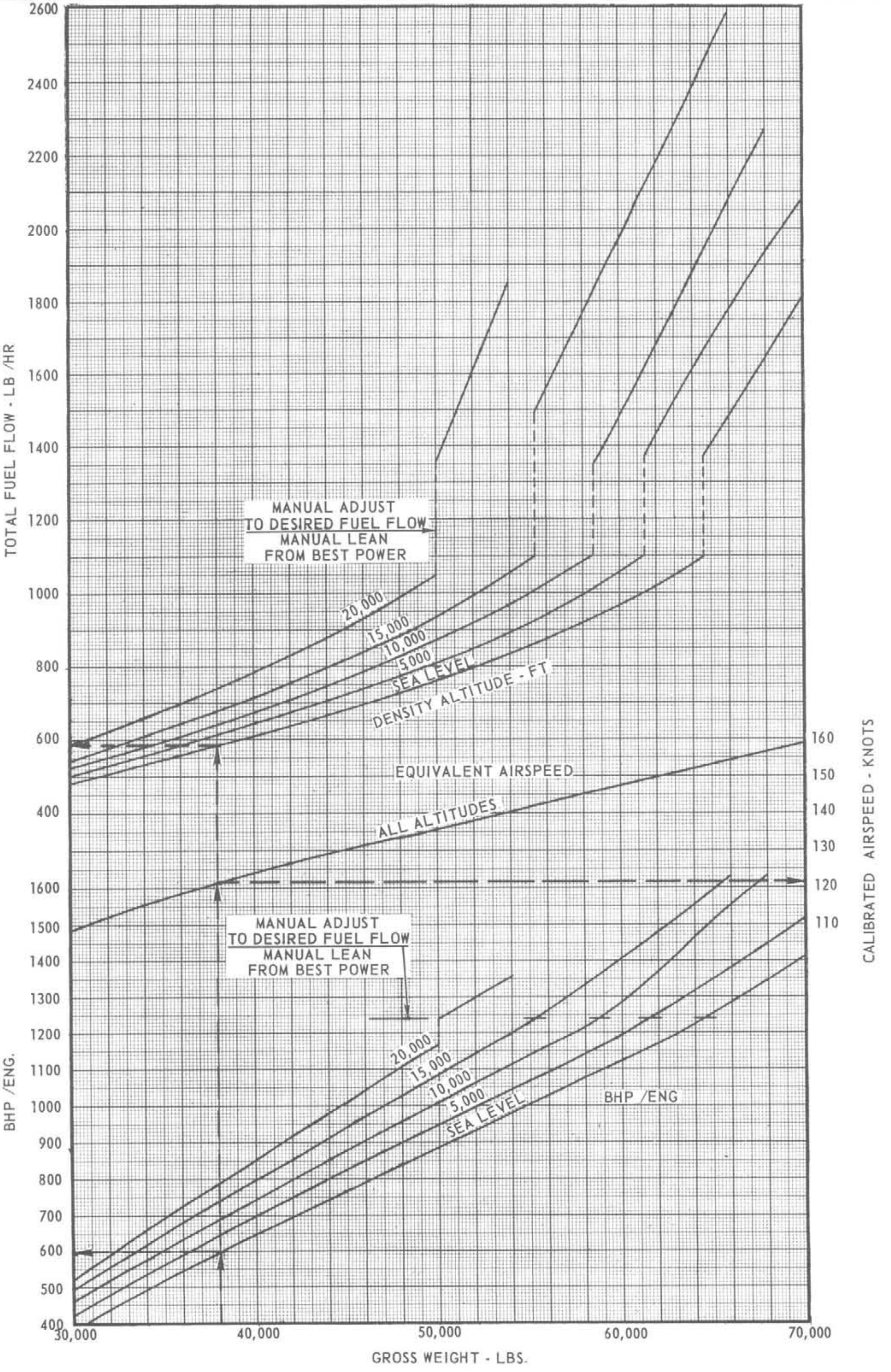
MODEL: C - 131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

CLEAN CONFIGURATION

STANDARD ATMOSPHERE

TWO ENGINES

ENGINES: R2800-99W



24,238B

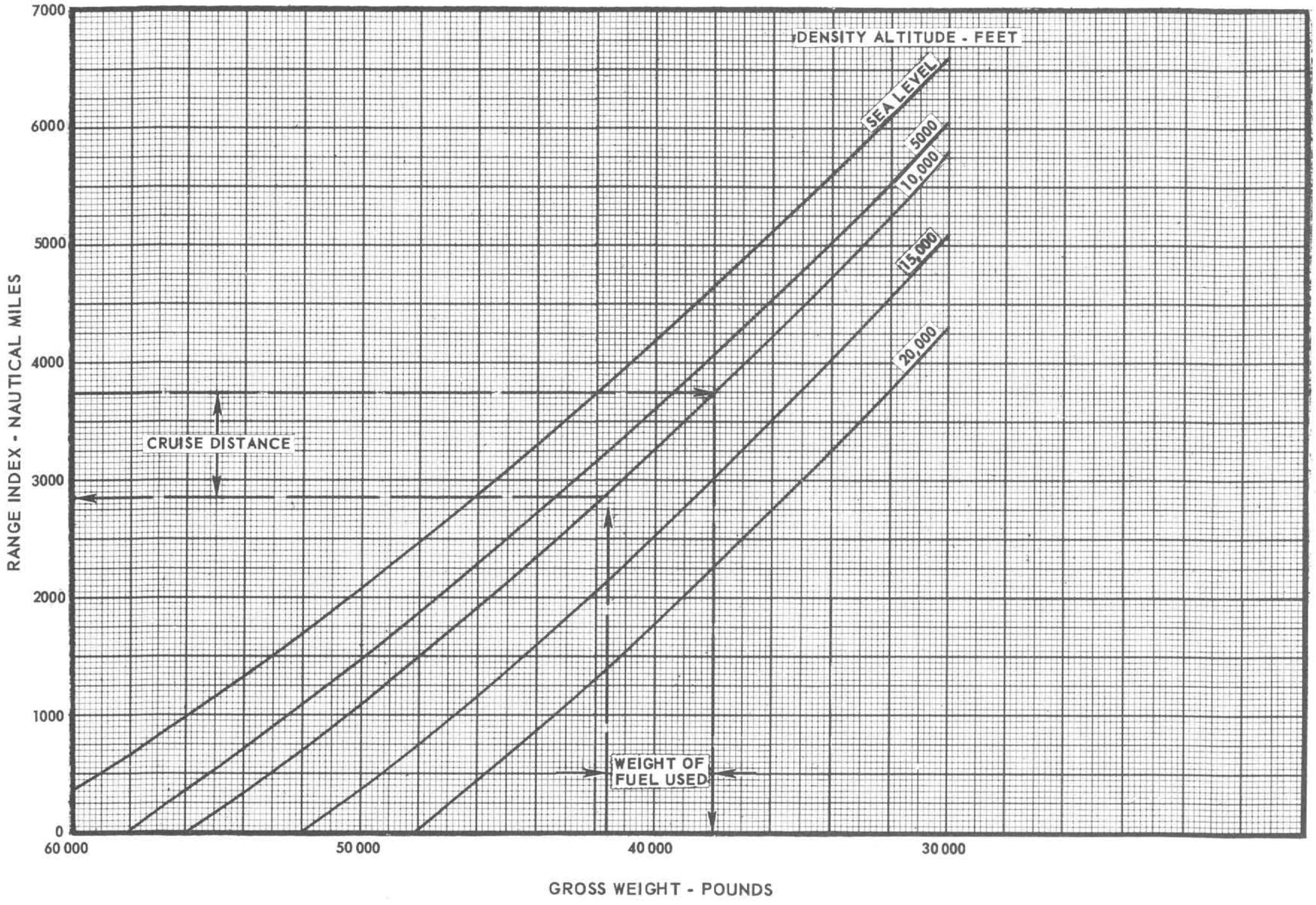
Figure A5-6

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

LONG RANGE PREDICTION - DISTANCE

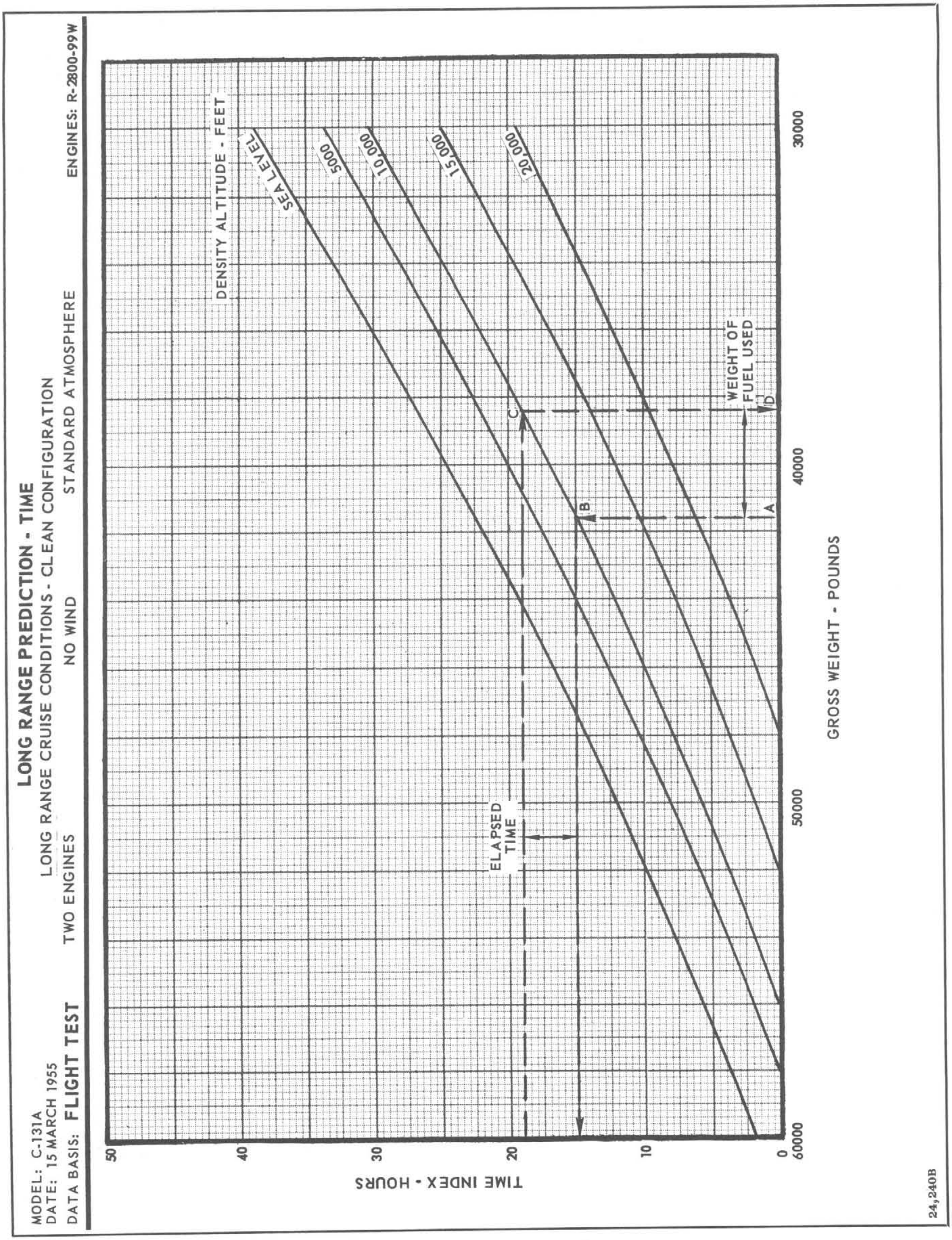
LONG RANGE CRUISE CONDITIONS - CLEAN CONFIGURATION

TWO ENGINES　NO WIND　STANDARD ATMOSPHERE　ENGINES: R2800-99W



24,239B

Figure A5-7



LONG RANGE PREDICTION - TIME

LONG RANGE CRUISE CONDITIONS - CLEAN CONFIGURATION

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

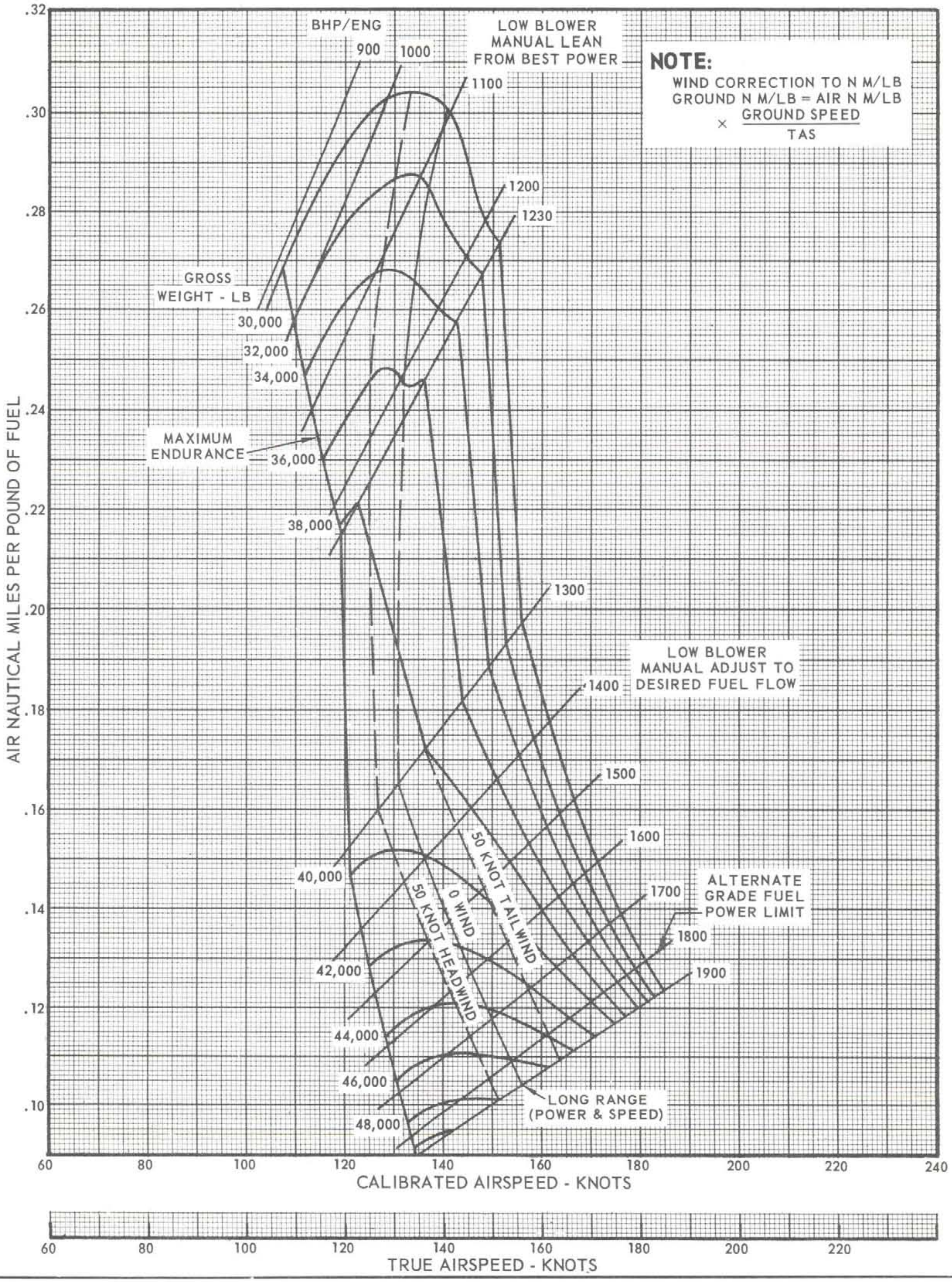
TWO ENGINES   NO WIND   STANDARD ATMOSPHERE   ENGINES: R-2800-99W

Figure A5-8

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

NAUTICAL MILES PER POUND OF FUEL - ONE ENGINE INOPERATIVE
SEA LEVEL

STANDARD ATMOSPHERE PROPELLER FEATHERED ENGINES: R2800-99W



24,244B

Figure A5-9

NAUTICAL MILES PER POUND OF FUEL - ONE ENGINE INOPERATIVE

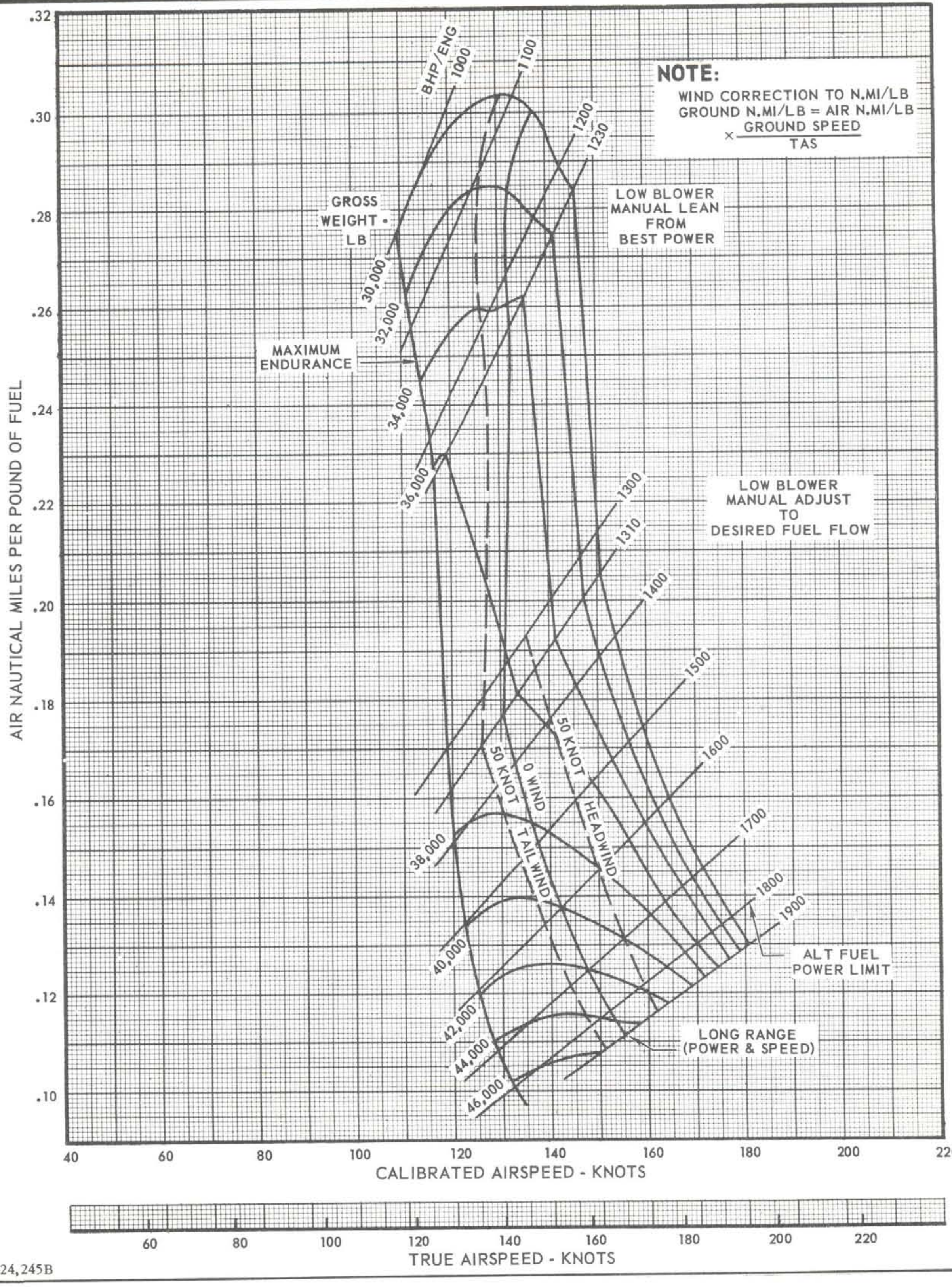
5000 FEET

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

PROPELLER FEATHERED

STANDARD ATMOSPHERE

ENGINES: R2800-99W



NOTE:
WIND CORRECTION TO N.MI/LB
GROUND N.MI/LB = AIR N.MI/LB × $\frac{\text{GROUND SPEED}}{\text{TAS}}$

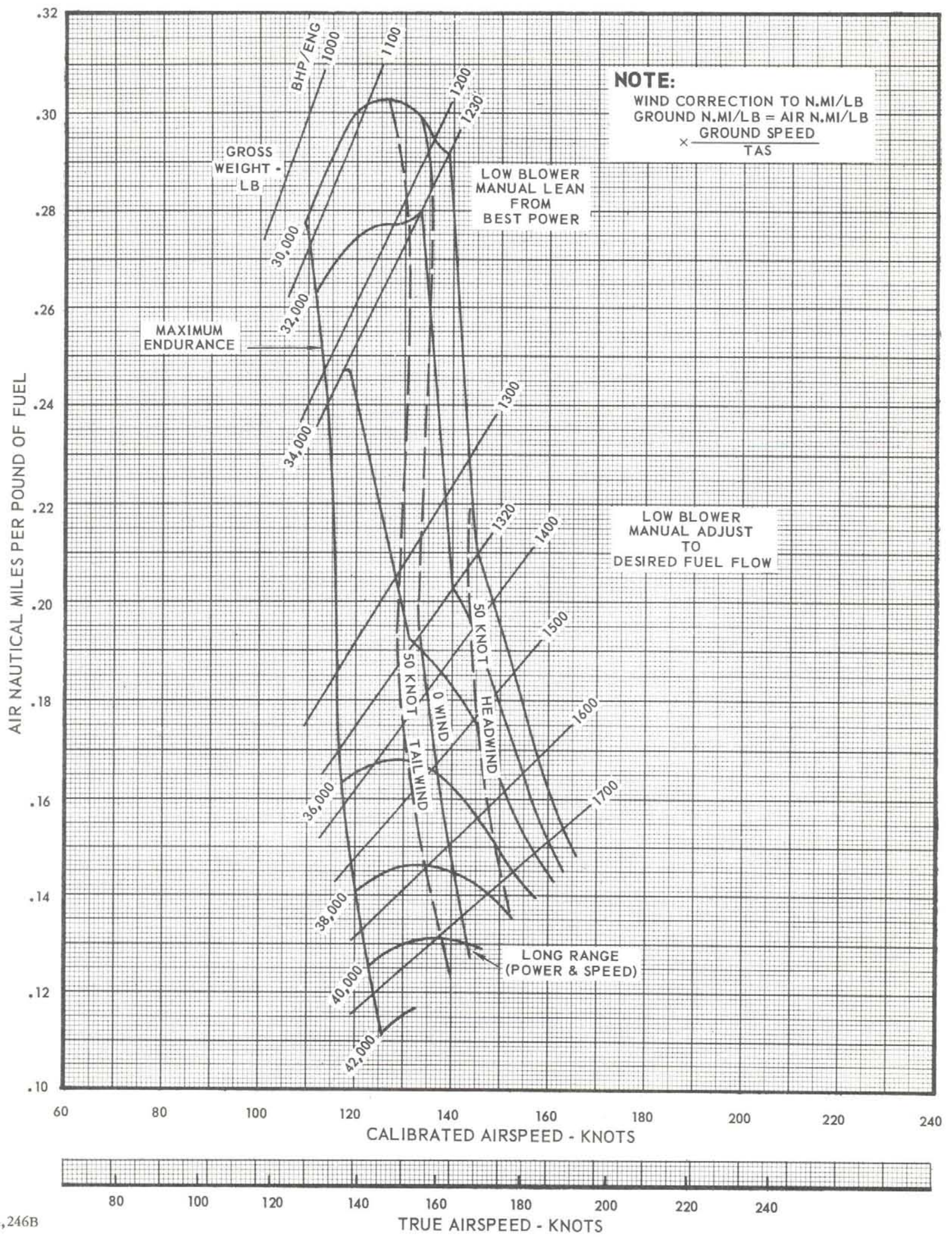
Figure A5-10

NAUTICAL MILES PER POUND OF FUEL - ONE ENGINE INOPERATIVE
10,000 FEET

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

STANDARD ATMOSPHERE   PROPELLER FEATHERED

ENGINES: R2800-99W



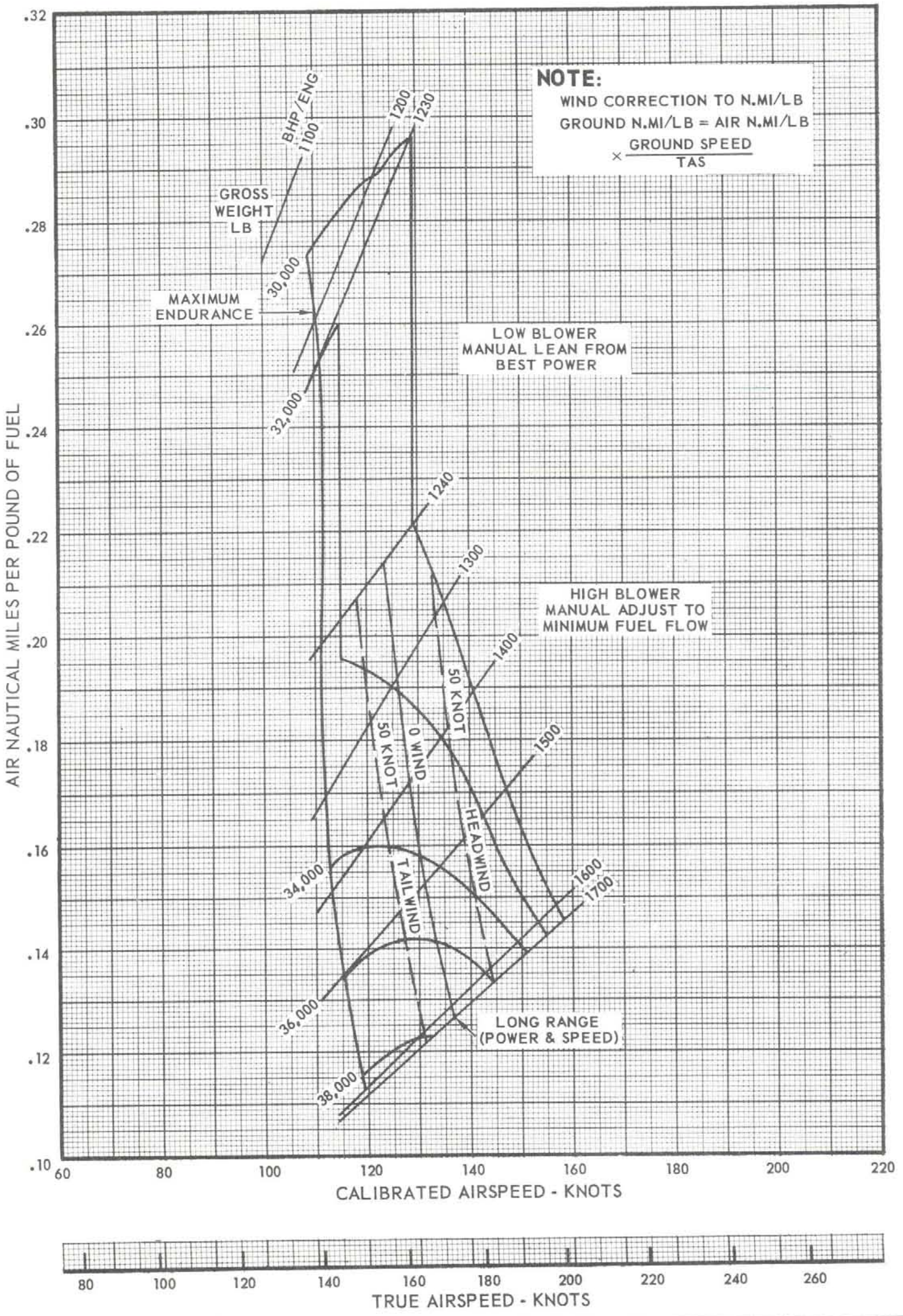
24,246B

Figure A5-11

NAUTICAL MILES PER POUND OF FUEL - ONE ENGINE INOPERATIVE

15,000 FEET

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**
STANDARD ATMOSPHERE
PROPELLER FEATHERED
ENGINES: R2800-99W



NOTE:
WIND CORRECTION TO N.MI/LB
GROUND N.MI/LB = AIR N.MI/LB × GROUND SPEED / TAS

24,247B

Figure A5-12

PART 6—APPROACH AND LANDING

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*The symbol * indicates an illustration*

APPROACH AND LANDING

Extending the flaps decreases the landing speed and decreases the landing field length. Wing flaps should not be extended to the landing position until the landing is assured. In normal flight planning, the greater of the available landing wing flap settings (39°, 28°, 20°, 15° and 0°) should be considered first. Specifically note that for each of the landing flap settings there is a corresponding approach flap setting. The selection of the landing flap setting should be based on the ability of the corresponding approach flap setting to assure adequate single-engine climb performance in the approach configuration in the event of a go-around or the need to lengthen the approach flight path. The recommended approach speeds are based on 130% of power-off stall speeds; touchdown at 120% of stall speed. Benefits derived from the brakes are maximum at the lower speeds and minimum at the higher speeds or just after touchdown. Unnecessary use of the brakes greatly reduces their life. Therefore, the landing distance required, as determined from the Appendix data, should be compared to the available runway length. Only in cases where the landing distance required equals the available field length should a minimum roll landing be made. When the available runway length is greater than the calculated minimum landing distance, as determined from the charts, the airplane can be stopped with less than maximum braking.

DISCUSSION OF CHARTS

Note

See landing pattern diagram, Section II.

APPROACH AND LANDING SPEEDS CHART

The recommended airspeeds for maneuver ($1.4V_{stall}$), approach ($1.3V_{stall}$), and touchdown ($1.2V_{stall}$) with landing gear down may be determined from the Approach and Landing Speeds Chart (figure A6-1). The chart is presented for the gross weight and flap setting operating range of the airplane. Power-off stall speeds are included on the chart.

EXAMPLE

Given:

Gross weight = 38,000 pounds
Flap setting – Approach = 12°
Flap setting – Touchdown = 28°

Enter chart at gross weight of 38,000 pounds (A) and read up to flap deflection of 12° (B). Read across to 1.3 stall speed (approach) line (C), and read up to find

IAS of 115 knots (D). For 28° flap deflection enter at gross weight of 38,000 pounds (A) and read up to 28° flap deflection (E). Read across to the 1.2 stall speed (touchdown) line (F), and read up for 100 knots IAS (G).

LANDING GROUND ROLL

Landing ground roll is defined as the distance from touch down to a stop using normal pilot techniques specified in Section II with brakes only (both propellers windmilling). For a minimum roll landing, it is important to initiate wing flap retraction as soon as possible after the airplane is firmly on the ground. Retracting the wing flaps decreases the wing lift and allows more weight to be applied to the main wheels, thus increasing the braking efficiency and shortening the landing roll. Reverse propeller thrust is recommended since it will appreciably shorten the landing roll. The landing ground roll charts (figures A6-2 through A6-6) present landing distance for density altitude, gross weight, and headwind.

EXAMPLE

Given:

Density altitude = 1800 feet
Gross weight = 36,000 pounds
Headwind = 5 knots
Flap setting = 28°

Select chart for 28° flap (figure A6-3). Enter chart at density altitude of 1800 feet (A). Read across to gross weight of 36,000 pounds (B) and read down to wind velocity curve and follow headwind curve to 5 knots (C) and read down to find distance of 3100 feet (D). To compute for landing distance from 50-ft height, multiply landing ground roll by 1.22 (3100 × 1.22 = 3775 feet).

Effects of Unusual Runway Conditions on Landing Ground Roll

The landing charts (figures A6-2 through A6-5) are based on landing on a dry hard surface and can be corrected for other surface conditions by multiplying ground roll by 1.35 for wet surface or 2.25 for icy surface.

APPROACH AND LANDING SPEEDS

LANDING GEAR DOWN

0° BANK

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

ENGINES: R2800-99W

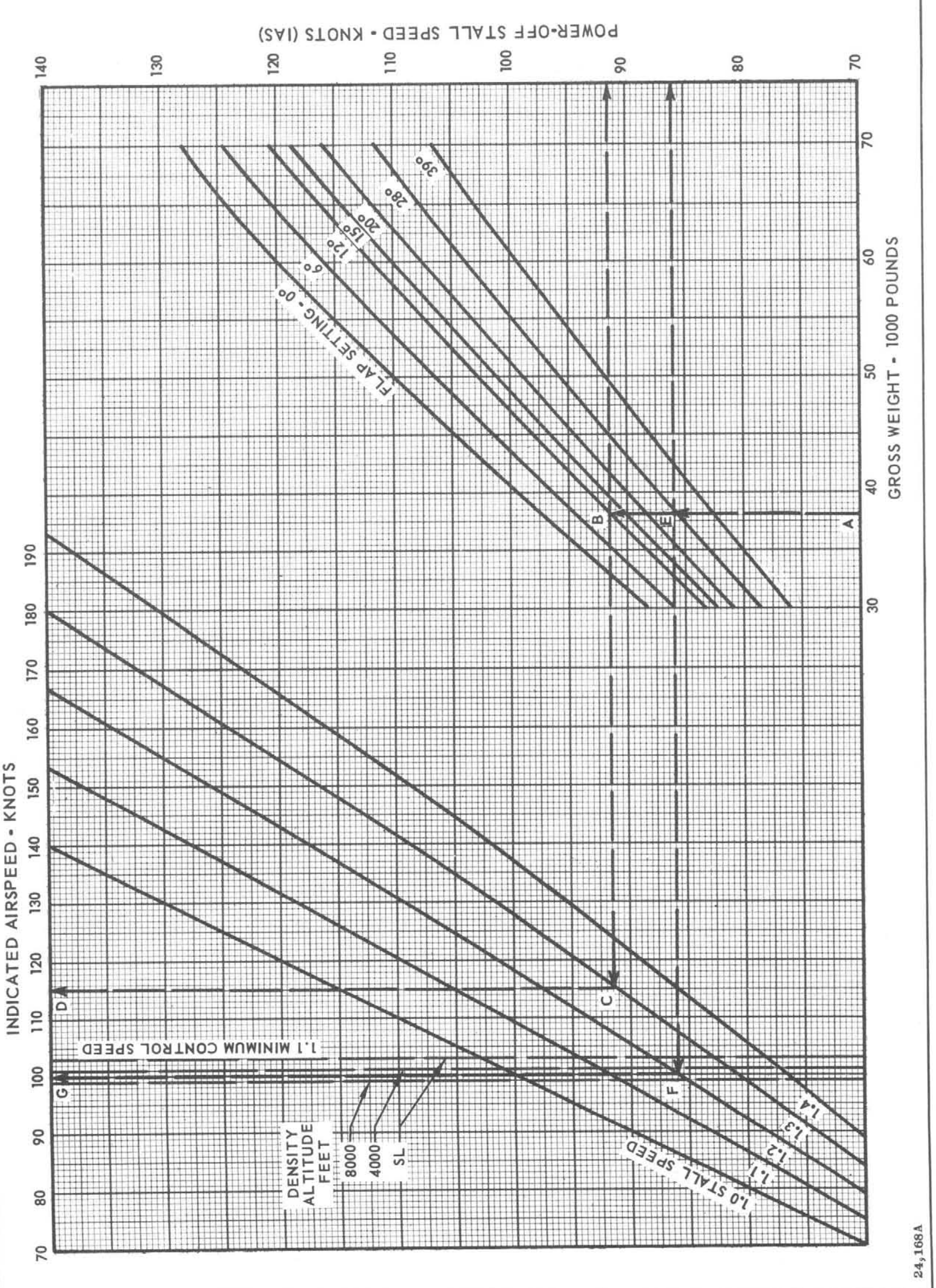


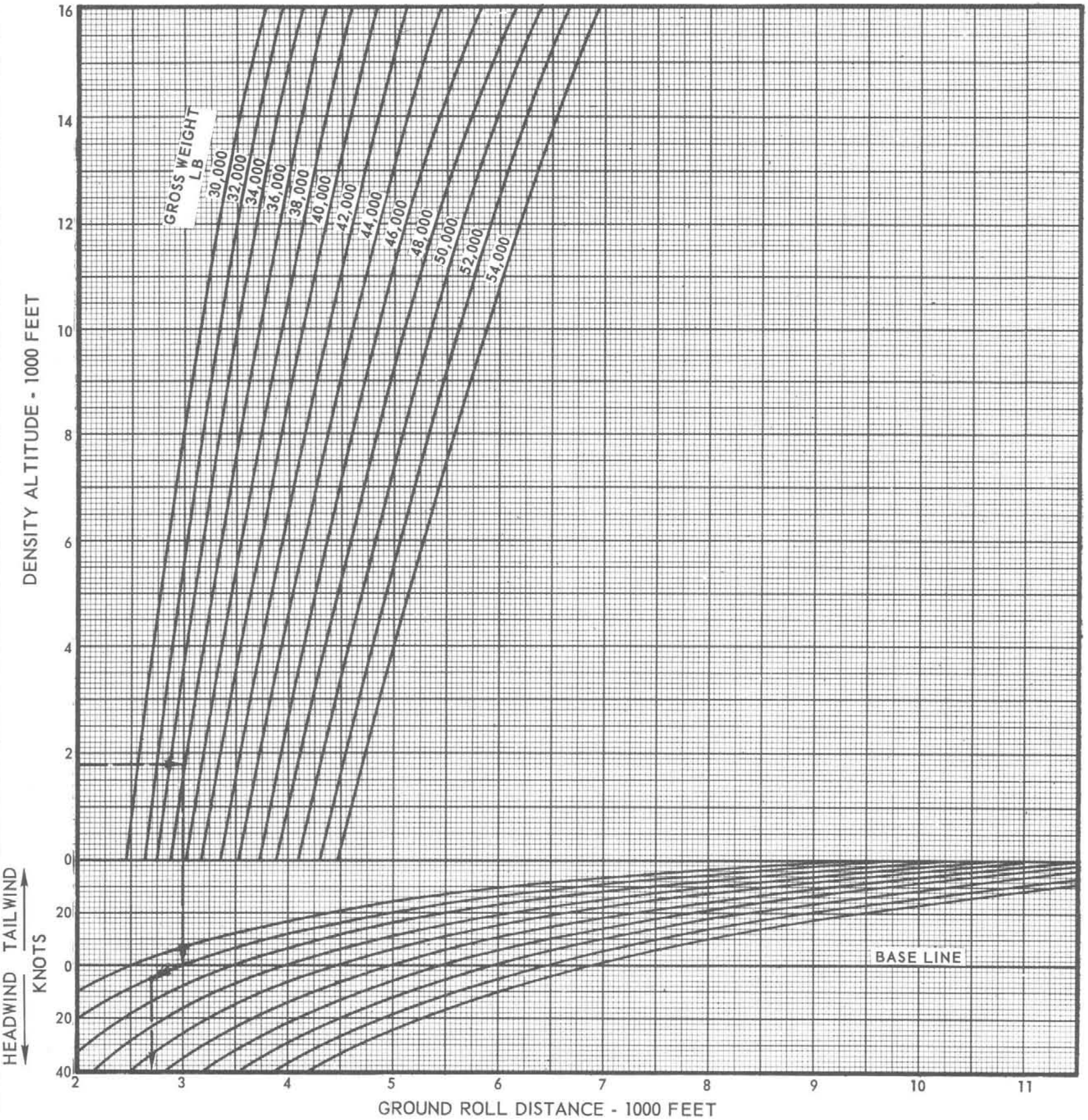
Figure A6-1

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

LANDING GROUND ROLL (39° FLAP)

APPROACH FLAP 20° BRAKES ONLY

ENGINES: R2800-99W



NOTES:

(1) GROUND ROLL IS FOR BRAKES ONLY, WITH PROPELLERS WINDMILLING. MAXIMUM REVERSE WILL REDUCE GROUND ROLL BY 45%.

(2) DISTANCES ARE BASED ON DRY HARD SURFACED RUNWAY WITH FLAP RETRACTION INITIATED AT 0.9 STALL SPEED.

(3) DO NOT EXTEND FLAPS MORE THAN 20° UNTIL LANDING IS ASSURED.

(4) TOUCHDOWN AT 1.2 POWER OFF STALL SPEED.

(5) LANDING FIELD LENGTH FROM 50 FEET HEIGHT IS 122% OF THE GROUND ROLL SHOWN.

(6) MULTIPLY LANDING GROUND ROLL BY 1.35 TO DETERMINE GROUND ROLL ON WET SURFACE; MULTIPLY BY 2.25 ON ICY SURFACE.

(7) 100% WIND ACCOUNTABILITY

45,453 B

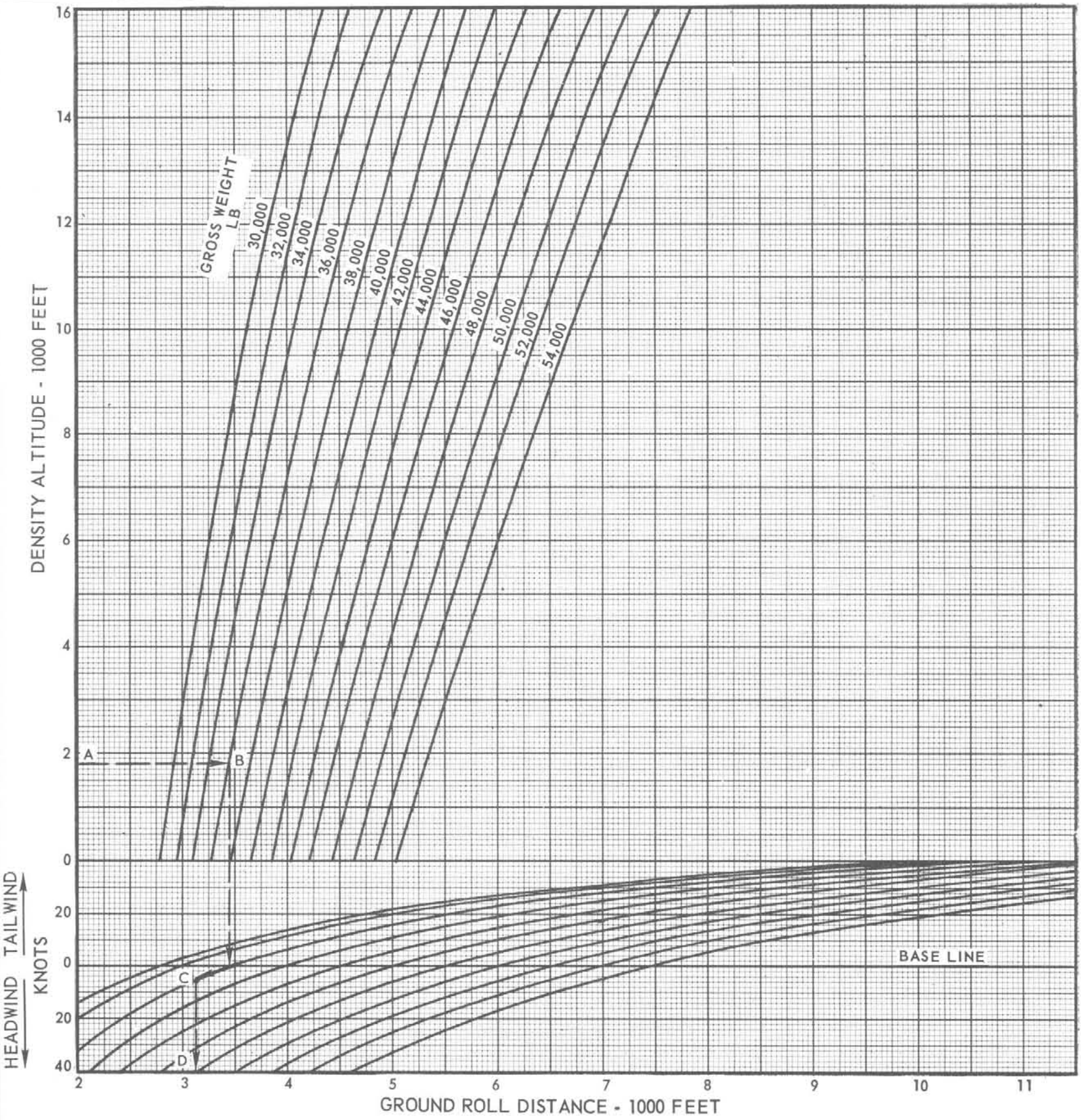
Figure A6-2

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

LANDING GROUND ROLL (28° FLAP)

APPROACH FLAP - 12° BRAKES ONLY

ENGINES: R2800-99W



NOTES:

(1) GROUND ROLL IS FOR BRAKES ONLY, WITH PROPELLERS WINDMILLING. MAXIMUM REVERSE WILL REDUCE GROUND ROLL BY 45%.

(2) DISTANCES ARE BASED ON DRY HARD SURFACED RUNWAY WITH FLAP RETRACTION INITIATED AT 0.9 STALL SPEED.

(3) DO NOT EXTEND FLAPS MORE THAN 12° UNTIL LANDING IS ASSURED.

(4) TOUCHDOWN AT 1.2 POWER OFF STALL SPEED.

(5) LANDING FIELD LENGTH FROM 50 FT HEIGHT IS 122% OF THE GROUND ROLL SHOWN.

(6) MULTIPLY GROUND ROLL DISTANCE BY 1.35 TO DETERMINE GROUND ROLL ON WET SURFACE. MULTIPLY BY 2.25 FOR ICY SURFACE.

(7) 100% WIND ACCOUNTABILITY.

45,455 B

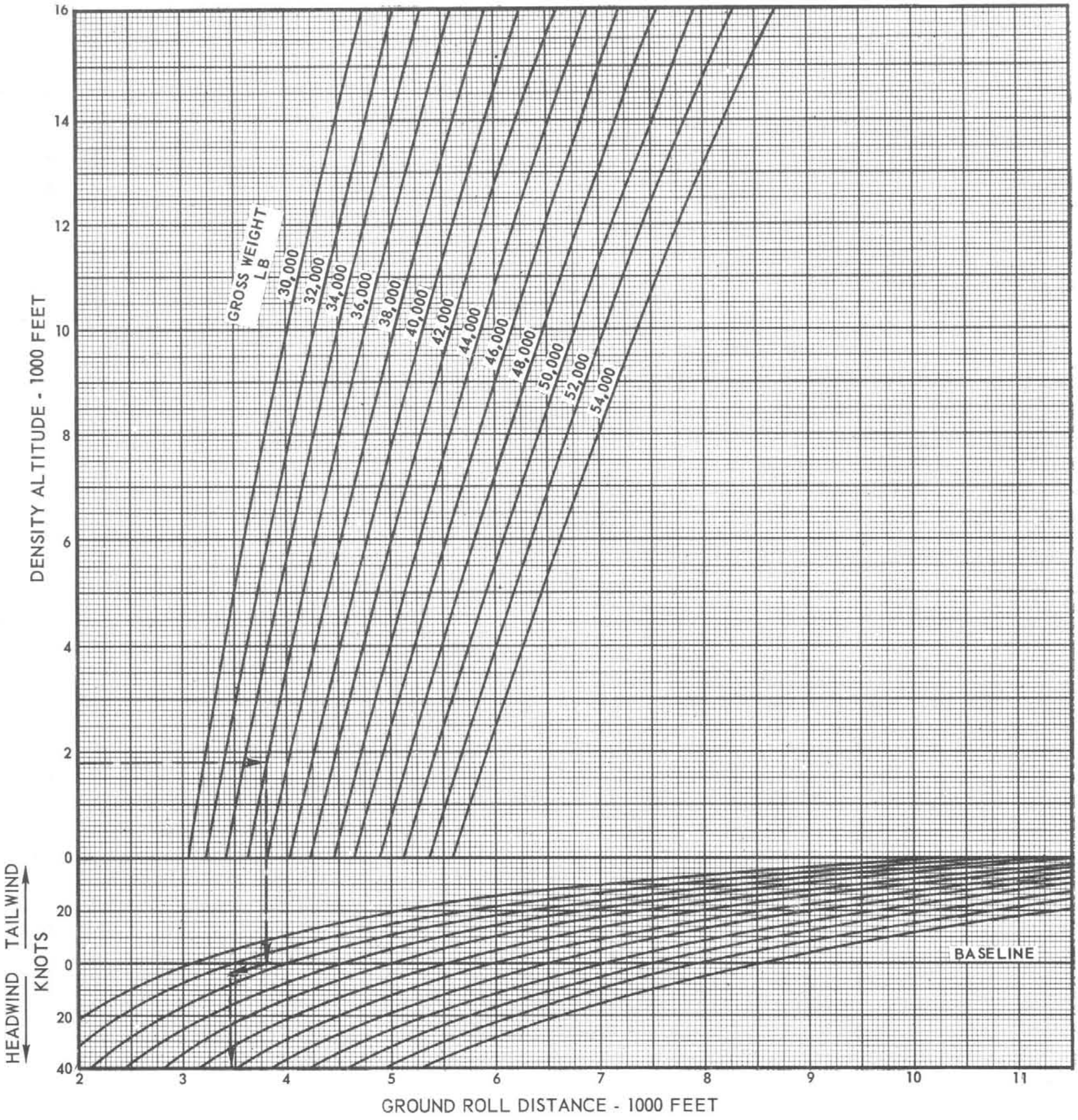
Figure A6-3

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

LANDING GROUND ROLL (20° FLAP)

APPROACH FLAP 6°
BRAKES ONLY

ENGINES: R2800-99W



NOTES:

(1) GROUND ROLL IS FOR BRAKES ONLY, WITH PROPELLERS WINDMILLING. MAXIMUM REVERSE WILL REDUCE GROUND ROLL BY 45%.

(2) DISTANCES ARE BASED ON DRY HARD SURFACED RUNWAY WITH FLAP RETRACTION INITIATED AT 0.9 STALL SPEED.

(3) DO NOT EXTEND FLAPS MORE THAN 6° UNTIL LANDING IS ASSURED.

(4) TOUCHDOWN AT 1.2 POWER OFF STALL SPEED.

(5) LANDING FIELD LENGTH FROM 50 FT HEIGHT IS 122% OF THE GROUND ROLL SHOWN.

(6) MULTIPLY GROUND ROLL DISTANCE BY 1.35 TO DETERMINE GROUND ROLL ON WET SURFACE. MULTIPLY BY 2.25 FOR ICY SURFACE.

(7) 100% WIND ACCOUNTABILITY.

45,976A

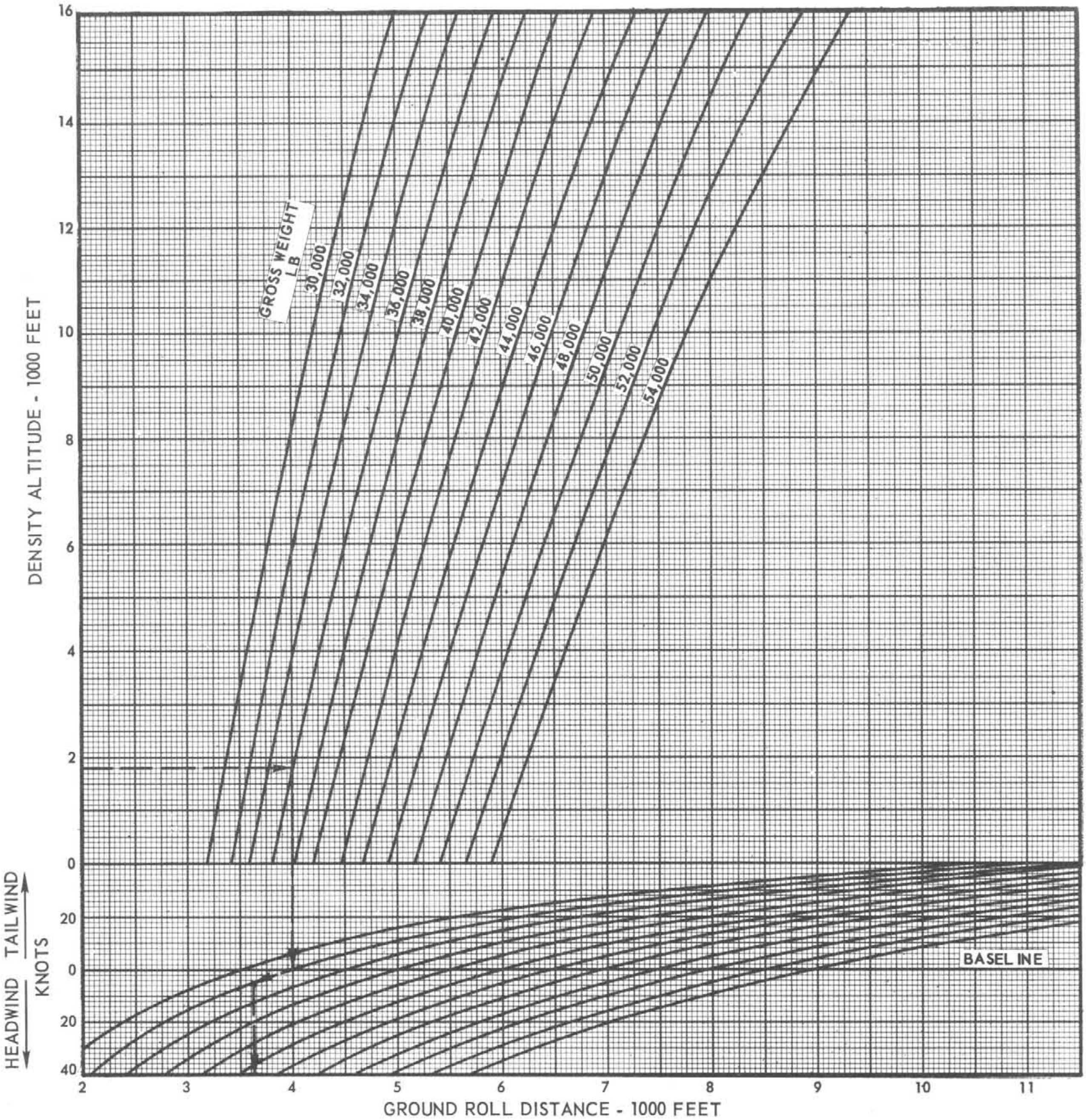
Figure A6-4

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

LANDING GROUND ROLL (15° FLAP)

APPROACH FLAP - 0° BRAKES ONLY

ENGINES: R2800-99W



NOTES:

(1) GROUND ROLL IS FOR BRAKES ONLY, WITH PROPELLERS WINDMILLING. MAXIMUM REVERSE WILL REDUCE GROUND ROLL BY 45%.

(2) DISTANCES ARE BASED ON DRY HARD SURFACED RUNWAY WITH FLAP RETRACTION INITIATED AT 0.9 STALL SPEED.

(3) DO NOT EXTEND FLAPS MORE THAN 0° UNTIL LANDING IS ASSURED.

(4) TOUCHDOWN AT 1.2 POWER OFF STALL SPEED.

(5) LANDING FIELD LENGTH FROM 50 FT HEIGHT IS 122% OF THE GROUND ROLL SHOWN.

(6) MULTIPLY GROUND ROLL DISTANCE BY 1.35 TO DETERMINE GROUND ROLL ON WET SURFACE. MULTIPLY BY 2.25 FOR ICY SURFACE.

(7) 100% WIND ACCOUNTABILITY.

45,457 B

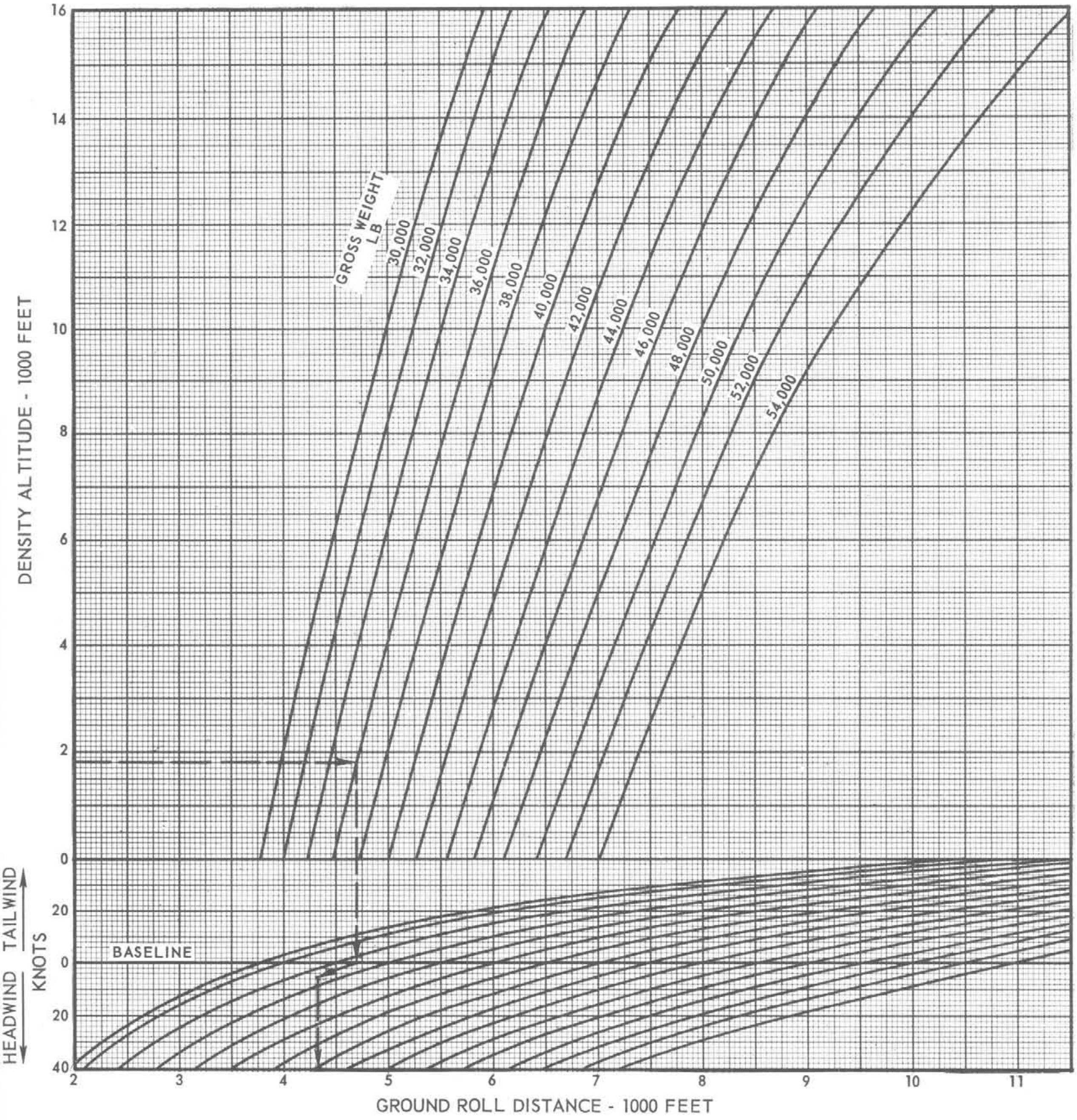
Figure A6-5

MODEL: C-131A
DATE: 15 MARCH 1955
DATA BASIS: **FLIGHT TEST**

LANDING GROUND ROLL (0° FLAP)

APPROACH FLAP - 0°
BRAKES ONLY

ENGINES: R2800-99W



NOTES:

(1) GROUND ROLL IS FOR BRAKES ONLY, WITH PROPELLER WINDMILLING. MAXIMUM REVERSE WILL REDUCE THE GROUND ROLL BY 45%.

(2) DISTANCES ARE BASED ON HARD DRY SURFACED RUNWAY WITH FLAP RETRACTION INITIATED AT 0.9 STALL SPEED.

(3) TOUCHDOWN AT 1.2 POWER OFF STALL SPEED.

(4) LANDING FIELD LENGTH FROM 50 FEET HEIGHT IS 122% OF THE GROUND ROLL SHOWN.

(5) MULTIPLY GROUND ROLL DISTANCE BY 1.35 TO DETERMINE GROUND ROLL ON WET SURFACE. MULTIPLY BY 2.25 FOR ICY SURFACE.

(6) 100% WIND ACCOUNTABILITY

45,459 B

Figure A6-6

PART 7—MISSION PLANNING

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MISSION PLANNING A7-1

TAKEOFF AND LANDING DATA CARD

C-131A TAKEOFF AND LANDING DATA CARD

CONDITIONS—TAKEOFF

Field Elevation ________ Gross Weight________

Runway Length _____ Headwind Component_____

OAT_____°C CAT_____°C Dew Point_____°F

Pressure Altitude_______ Density Altitude_______

TAKEOFF

(Optional)

Manifold Pressure _____Wet _____Dry

Expected TPSI _____Wet _____Dry

Minimum TPSI _____Wet _____Dry

Takeoff Flap Setting _____Wet _____Dry

Critical Field Length _____Wet _____Dry

Go-No-Go Marker No/Time _____Wet _____Dry

Go-No-Go Airspeed (KIAS) _____Wet _____Dry

Refusal Speed (KIAS) _____Wet _____Dry

Takeoff Speed (KIAS)____________________

Single-Engine Climb Speed (KIAS Clean)_______

Single Engine Ceiling (METO Power)________

LANDING IMMEDIATELY AFTER TAKEOFF

Approach Flaps____________________

Approach Speed 1.3 Stall Speed (KIAS)________

Go-Around Speed (KIAS Approach Flaps)______

Landing Flaps____________________

Approach Speed 1.3 Stall Speed (KIAS)________

Landing Distance/Ground Roll____________

CONDITIONS—LANDING

Field Elevation____________________

Runway Length________ Gross Weight________

OAT________°C Dew Point________°F

Headwind Component____________________

Pressure Altitude____________________

Density Altitude____________________

LANDING

Approach Flaps____________________

Approach Speed 1.3 Stall Speed (KIAS) ________

Go-Around Speed (KIAS Approach Flaps)______

Go-Around Speed (KIAS Clean)____________

Landing Flaps____________________

Approach Speed 1.3 Stall Speed (KIAS)________

Landing Distance/Ground Roll ____________

Prior to each flight it is necessary to compute and fill in the data listed on the Takeoff and Landing Data Card contained in the abbreviated checklist, T. O. 1C-131A-CL-1-1. Completion of both takeoff and landing after takeoff data is necessary in the event of an emergency landing after takeoff. The information for "Landing Immediately After Takeoff" should be based on the takeoff gross weight. If weather information at destination is not available before takeoff, the landing portion of the card may be completed before landing.

Note

> Go-no-go marker no/time and go-no-go airspeed (KIAS) are not required when refusal speed is greater than takeoff speed. These items should be computed, however, if the runway is covered with ice, snow, or slush. Single-engine ceiling (METO power) need be computed only if terrain may be a factor in the event of engine failure after takeoff.

MISSION PLANNING

Adequate planning is an essential part of the successful performance of any mission. The scope of this discussion is limited to consideration of airplane performance and associated planning procedures. The procedures suggested by the sample flight problem facilitate safe operation of the airplane in all phases of the mission and aid in better judgment and quicker action in the event of an emergency.

Sample Flight Problem

To illustrate the use of the charts in this Appendix, a sample flight problem is presented and solved in the following paragraphs.

Weather, Field and Trip Information

Field Elevation Pressure Altitude	*50 ft*
Outside air temperature	*25°C*
Dew point	*65°F*
Headwind	*10 knots*
Runway length	*5000 ft*
Runway slope	*1% up*
Airplane operating weight	*29,858 lb*
Trip length	*930 n mi*

Weather and Field Information at Destination

Field elevation pressure altitude	*5420 ft*
Outside air temperature	*20°C*
Dew point	*50°F*
Headwind	*10 knots*
Runway length	*8100 ft*

Determine Density Altitude

Using: (Density Altitude Chart, figure A1-1)

Enter chart at OAT.	*25°C*
Proceed vertically to pressure altitude line	*50 ft*
Proceed horizontally to density altitude scale	
Read density altitude	*1200 ft*

Determine Cruise Weight Due to Terrain

The range charts and the climb charts are used to determine the fuel required for the mission. For the purpose of this sample problem a minimum enroute altitude of 10,000 feet will be used. This altitude will allow for a vertical terrain clearance of at least 2000 feet at any point along the flight path.

Using: (Ceiling — One Engine Inoperative Chart, figure A4-7)

Enter chart on altitude base line at	*10,000 ft*
Proceed horizontally to interception of Meto power curve at absolute ceiling, then proceed vertically to gross weight scale and read gross weight	*41,600 lb*

Note

It is important to remember that this weight is the weight of the airplane at start of cruise at 10,000 feet. To this weight will be added the necessary fuel weight for the climb to the cruise altitude.

Determine Takeoff Weight

Note

The airplane's lift and drag depend primarily upon the density of the air, while the engine power depends upon the pressure of the air, until full throttle is reached. To determine the climb performance under nonstandard conditions, one must determine the fuel, distance and time to climb using density altitudes and obtain the standard power for that altitude by adjusting the manifold pressures as required.

Using: (Operational Climb — Distance and Fuel, figure A4-2)

Note airspeed (IAS)	*145 knots*
Enter chart at gross weight of	*41,600 lb*
Proceed vertically to density altitude curve	*10,000 ft*
Read horizontally to distance	*30 n mi*
Parallel guide line to fuel consumed in climb scale and read	*425 lb*
Parallel guide lines to density altitude at start of climb	*1200 ft*
Read: Distance	*2 n mi*
Fuel	*25 lb*
Subtract start-of-climb values from end of climb values to determine:	
Distance in climb	*28 n mi*
Fuel consumed in climb	*400 lb*
Add fuel consumed in climb to weight at end of climb to determine:	
Takeoff weight	*42,000 lb*

Note

This weight represents maximum takeoff weight for safe single engine operation for enroute terrain clearance.

Determine Ramp Weight

Ramp weight represents a weight greater than maximum takeoff weight and is allowed for starting, runup and takeoff. This fuel allowance is assumed to be equal to that used in 10 minutes at METO power at sea level. This fuel allowance may be specified by the operations office instead of the allowance made above.

Using: (Fuel Flow per Engine – Low Blower, figure A2-25)

Enter chart at Meto power	*1900 bhp*
Proceed vertically to engine rpm scale	*2600 rpm*
Read fuel flow	*1490 lb/hr/eng*
Fuel consumed by both engines for 10 minutes operation (1490× 2 eng×10 min÷60 min/hr)	*497 lb*
Ramp weight equals 42,000+497	*42,497 lb*

Determine Fuel Used in Cruise

Using: (Long Range Prediction – Distance, figure A5-7)

Enter chart at weight at start of cruise	*41,600 lb*
Proceed vertically to density altitude line	*10,000 ft*
Read distance at start	*2850 n mi*
Add required cruise distance (930 n mi trip minus 28 n mi used to climb leaves 902 n mi in cruise), find distance index at end of cruise	*3752 n mi*
Proceed horizontally to density altitude lines	*10,000 ft*
Read weight at end of cruise	*38,000 lb*
Subtract weight at end of cruise from weight at start of cruise to find approximate fuel used in 902 n mi cruise (41,600−38,000)	*3600 lb*

Determine Reserve Fuel Allowance

The reserve fuel allowance should include fuel for holding at destination and the possibility of being diverted to an alternate base, and some additional fuel for contingencies. For the purpose of this example the reserve fuel allowance is that required for 30 minutes holding at airspeeds for long range at sea level and 5% of trip fuel for contingencies.

Using: (Nautical Miles per Pound of Fuel – Sea Level, figure A5-1)

Enter chart with weight at end of cruise	*38,000 lb*
Follow weight line to intersection of long range line, then proceed horizontally to air nautical miles per pound of fuel and read	*0.234 n mi/lb*
Proceed vertically to true airspeed	*168 knots*
Divide airspeed by n mi/lb (168÷0.234)	*720 lb/hr*
Allowance for 30 minutes holding (720×0.5)	*360 lb*
Contingency reserve (4000×0.05)	*200 lb*
Total reserve fuel	*560 lb*

Determine Payload

Ramp weight	*42,497 lb*
Airplane operating weight	*29,858 lb*
Total fuel load	*5057 lb*
Zero fuel weight (42,497−5057)	*37,440 lb*
Allowable payload (37,440−29,858)	*7582 lb*

TAKEOFF

Determine the Minimum Performance Torque Pressure

Note

If the actual carburetor temperature rise of the airplane is unknown, use OAT; it is sufficiently accurate for preflight planning. A correction should be made when the actual CAT is known.

Using: (Maximum Wet Power Available, Figure A2-1)

Enter chart with airplane pressure altitude	*50 ft*
Proceed vertically to CAT (OAT)	*25°C*
Read MAP	*62 in. Hg*
Proceed horizontally to base line of dew point chart, then parallel the sea guide line to dew point	*65°F*
Then, proceed horizontally to read:	
Expected TPSI	*135 psi*
Minimum Performance TPSI	*128 psi*

Also Note:

Brake Horsepower	*2380 bhp*
Engine speed	*2800 rpm*
Blower speed	*LOW*
Water injection	*ON*
Mixture position	*AUTO RICH*

In preflight planning, do not exceed the minimum performance TPSI limit shown. In operation, do not exceed the expected TPSI limit of 141 psi with wet power or 130 psi with dry power. In the event that this minimum performance TPSI is unobtainable before reaching refusal speed, the takeoff should be aborted.

Determine the Maximum Allowable Takeoff Flap Setting

For the purpose of this sample problem the desired minimum initial rate of climb is considered to be 300 fpm.

Using: (Takeoff Gross Weight Limited by Climb, figure A3-3)

Enter lower left-hand portion of chart with density altitude	*1200 ft*
Proceed horizontally to desired minimum initial rate of climb	*300 fpm*
Parallel guide lines to base line at sea level density altitude, then proceed vertically to minimum performance torque pressure	*128 psi*
Parallel guide lines to base line at 141 psi then proceed vertically to takeoff weight	*42,000 lb*
Read takeoff flap setting	*12°*

Note

- For practical operation, limit the final selection of takeoff flap setting to either 12°, 6° or 0°. Intermediate positions should be used only when one of these flap settings will not provide the required initial rate of climb and runway length combination.
- If the takeoff flap setting should come out as less than zero, with the particular takeoff atmospheric conditions available, off-load as necessary to reduce the takeoff weight to that which allows the desired initial rate of climb. Or, if under similar conditions, the takeoff weight cannot be reduced, work backwards from the weight and minimum flap setting to determine the expected initial rate of climb and thereby judge the desirability of continuing the flight.

Determine Takeoff Speed

Using: (Takeoff and Minimum Control Speeds, figure A3-7)

Enter chart at gross weight	*42,000 lb*
Proceed vertically to 12° flap curve, then proceed horizontally to IAS scale and read	*114 knots*

Determine Critical Field Length

Using: (Critical Field Length, 12° Flap, figure A3-11)

Enter chart with density altitude	*1200 ft*
Parallel guide lines to minimum performance torque pressure	*128 psi*
Proceed horizontally to takeoff weight	*42,000 lb*
Proceed vertically to zero runway slope parallel guide lines to actual runway slope	*1% up*
Proceed vertically to base line at zero headwind, parallel guide lines to ½ reported headwind	*5 knots*
Proceed vertically to Critical Field Length	*3850 ft*

Note

This field length is that required to accelerate to the critical engine failure speed, two engines operating, have an engine fail, propeller autofeather and either (a) proceed to takeoff or (b) stop. Since the critical field length is less than that available, a safe takeoff is possible.

Determine Refusal Speed

Using: (Refusal Speed, 12° Flap, figure A3-12)

Enter chart with available runway length	*5000 ft*
Proceed horizontally to ½ reported headwind	*5 knots*
Parallel guide line to base line, then proceed horizontally to torque pressure	*128 psi*
Parallel guide line to base line, then proceed horizontally to density altitude	*1200 ft*
Parallel guide line to base line, then proceed horizontally to intersection of vertical line from gross weight	*42,000 lb*
Read refusal speed (IAS)	*108 knots*
Also find MA wind refusal speed	*105 knots*

Note

If the refusal speed should be greater than the takeoff speed and since refusal speed is limited to takeoff speed, then only takeoff speed would need to be monitored.

Determine Takeoff Ground Run

Using: (Takeoff Ground Run – 12° Flap, figure A3-13)

Enter chart with density altitude	*1200 ft*
Parallel guide lines to minimum performance torque pressure	*128 psi*

Proceed horizontally to takeoff weight	*42,000 lb*
Proceed vertically to base line at zero runway slope, then parallel guide lines to actual runway slope	*1% up*
Proceed vertically to base line at zero headwind, then parallel guide lines to ½ reported headwind	*5 knots*
Proceed vertically to ground run distance	*2750 ft*
Also find no wind ground run	*3000 ft*

Determine Go-No-Go Distance and Speed

Using: (Velocity During Takeoff Ground Run, figure A3-5)

Enter chart with zero wind takeoff ground run	*3000 ft*
And takeoff speed (IAS)	*114 knots*
Draw acceleration curve through the point of intersection and parallel to the guide lines	
Re-enter chart at zero wind refusal speed	*105 knots*
Proceed vertically to new acceleration check curve and then horizontally to refusal distance	*2400 ft*
Re-enter chart at go-no-go marker distance (1st 1000 ft marker before refusal distance)	*2000 ft*
Proceed horizontally to new acceleration check curve and read $T\,X\frac{1}{\sqrt{\sigma}}$ *seconds for sea level standard atmosphere*	*25 seconds*
Proceed vertically to IAS scale and read normal acceleration speed (zero wind) IAS	*98 knots*
Find acceleration time for 1200 ft. density altitude	
$\left(T\,X\frac{1}{\sqrt{\sigma}}\right)\div\frac{1}{\sqrt{\sigma}}=\frac{25\text{ seconds}}{1.017}=$	*25 seconds*
Correct the no wind speed by subtracting the −9 knots speed tolerance from the Speed Tolerance Chart (figure A3-6) to obtain go-no-go speed	*89 knots*
Correct this value for headwind of 5 knots (½ reported headwind) for final corrected go-no-go speed	*93 knots*

Summary of Preflight Takeoff Data

Engine Speed	*2800 rpm*
MAP	*62 in. Hg*
Minimum performance torque pressure	*128 psi*
Blower speed	*LOW*
Mixture position	*AUTO RICH*
Flap setting	*12°*
Takeoff speed (IAS)	*114 knots*
Go-no-go airspeed	*93 knots*
Go-no-go distance	*2000 ft*
Takeoff ground run	*2750 ft*

CLIMB

Determine Power Setting at Start of Climb

Using: (Climb Power Schedule — 1400 BHP/2400 RPM, figure A2-7)

Enter table with pressure altitude	*Sea level*
Proceed horizontally to CAT.	*25°C*
Interpolate between 20°C and 30°C for MAP	*39.9 in. Hg*
Blower	*LOW*
Engine speed	*2400 rpm*
Torque pressure	*92 psi*
Desired fuel flow	*1065 lb/hr*

Also note:

Mixture	*AUTO RICH*

Determine Power Settings at End of Climb

Using: (Climb Power Schedule — 1400 BHP, 2400 RPM, figure A2-7)

Re-enter table with pressure altitude	*10,000 ft*
Proceed horizontally to CAT.	*0°C*
Read MAP	*36.3 in. Hg*
Blower	*LOW*
Engine speed	*2400 rpm*
Torque pressure	*92 psi*
Desired fuel flow	*1065 lb/hr*

Also note:

Mixture	*AUTO RICH*

CRUISE

Determine Airspeed and Power Settings for Cruise

Using: (Nautical Miles per Pound of Fuel—10,000 Feet, figure A5-3)

Enter at weight at start of cruise	*41,600 lb*
Follow weight line to intersection of long-range line and read BHP at start of cruise	*1000 bhp*
Proceed vertically to calibrated airspeed	*167 knots*
Re-enter at weight at end of cruise	*38,000 lb*
Follow weight line to intersection of long-range line and read BHP at end of cruise	*925 bhp*
Proceed vertically to calibrated airspeed	*165 knots*

Using: (Power Schedule—1000 BHP, figure A2-15)

Enter table at pressure altitude	*10,000 ft*
Proceed horizontally to CAT.	*0°C*
Read MAP	*31.9 in. Hg*
Blower	*LOW*
Engine speed	*1900 rpm*
TPSI	*83 psi*

Also note:

Mixture	*Manual Lean*

Using: (Power Schedule—900 BHP, figure A2-13)

Enter table with pressure altitude	*10,000 ft*
Proceed horizontally to CAT.	*0°C*
Read MAP	*30.6 in. Hg*
Blower	*LOW*
Engine speed	*1800 rpm*

Determine MAP for 925 bhp, 1800 rpm, at end of cruise by using the following ratio:

$$\frac{30.6 \text{ in. Hg}}{900 \text{ bhp}} = \frac{MAP}{925}$$

$$MAP = \frac{30.6 \times 925}{900} = \qquad 31.5 \text{ in. Hg}$$

Determine TPSI at end of cruise by using the formula

$$TPSI = \frac{BHP}{RPM \times .00632}$$

$$BMEP = \frac{925}{1800 \times .00632} = \qquad 81 \text{ psi}$$

LANDING

Landing Conditions

Field elevation pressure altitude	*5420 ft*
Outside air temperature	*20°C*
Dew point	*50°F*
Headwind	*10 knots*
Runway length	*8100 ft*
Landing weight (takeoff weight less fuel for mission, except total reserve) (42,000−4000)	*38,000 lb*

Determine Power Settings for Emergency Go-Around (If Necessary)

Using: (Maximum Wet Power Available, figure A2-1)

Enter chart with pressure altitude	*5420 ft*
Proceed vertically to CAT.	*20°C*
Read MAP	*54.1 in. Hg*
Proceed horizontally to dew point chart base line then parallel guide line to reported dew point corrected for altitude	*50°F*
Then horizontally to minimum performance TPSI	*113.5 psi*

Also note:

Engine speed	*2800 rpm*
Blower speed	*LOW*
Mixture position	*AUTO RICH*

Determine Density Altitude at Destination

Using: (Density Altitude Chart, figure A1-1)

Density Altitude	*7200 ft*

Determine the Approach and Landing Flap Positions

Note

Each approach flap setting has a corresponding landing flap setting. The approach flap setting is felt to be the more important of the two based on the possibility of a single-engine go-around.

Using: (Takeoff Gross Weight Limited by Climb, figure A3-3)

Use same procedure as that outlined in determining maximum allowable takeoff flap setting with 300 fpm desired rate of climb. Final selection of approach flap setting	*6°*

Determine Approach and Go-Around Speeds

Using: (Approach and Landing Speed Chart, figure A6-1)

Enter chart with gross weight	*38,000 lb*
Proceed vertically to stall speed line for approach flap	*6°*
Proceed horizontally to approach speed line (1.3 stall) then vertically to read approach speed (IAS)	*120 knots*
Repeat procedure for 20° flap to find approach speed (IAS)	*111 knots*
and landing speed (1.2 stall)	*103 knots*

Determine Landing Distance/Ground Roll

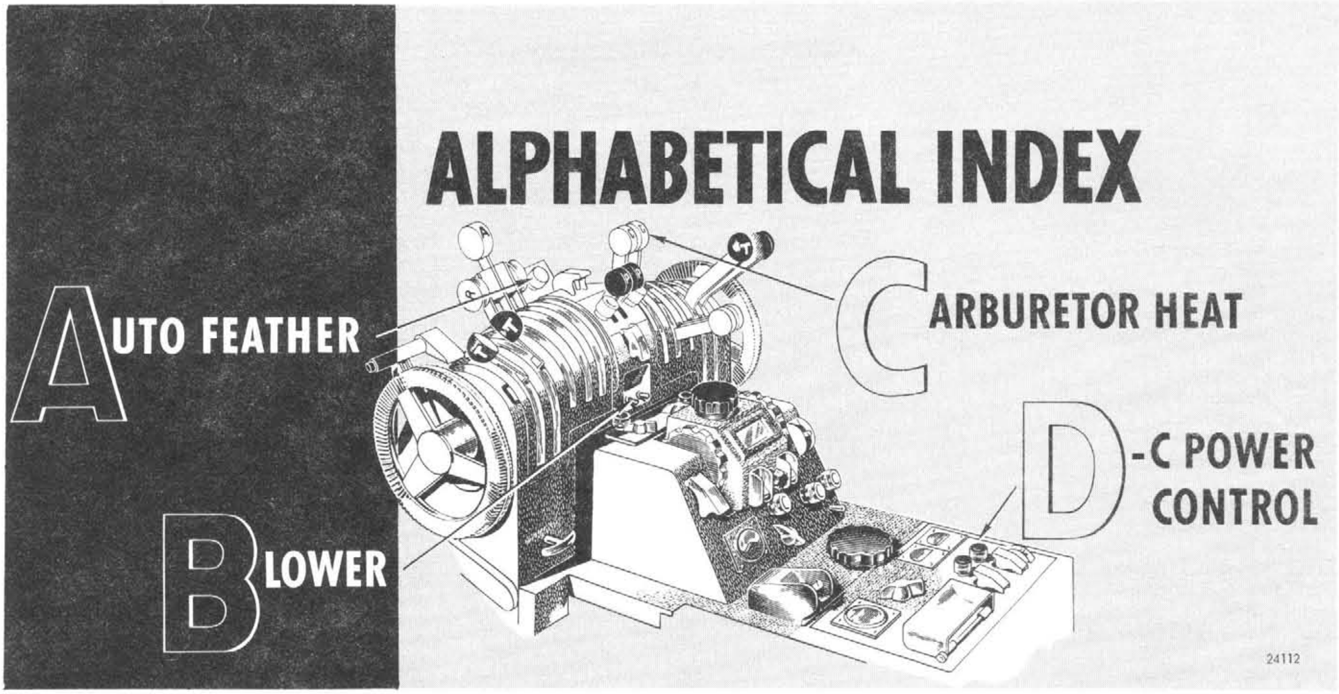
Using: Landing Ground Roll – 20° Flap, figure A6-4)

Enter chart with density altitude	*7200 ft*
Proceed horizontally to gross weight curve	*38,000 lb*
Proceed vertically to base line at 0 headwind and parallel guide lines to ½ reported headwind	*5 knots*
Proceed vertically to landing ground roll	*4200 ft*
Landing distance from 50 ft. altitude (4200 × 1.22)	*5124 ft*

Summary of Approach and Landing Data

Engine Speed	*2800 rpm*
Minimum Performance TPSI	*113.5 psi*
MAP	*54.1 in. Hg*
Blower Speed	*LOW*
Mixture Position	*AUTO RICH*
Approach Flap Setting	*6°*
Approach Speed (IAS)	*120 knots*
Landing Flap Setting	*15°*
Approach Speed (IAS)	*111 knots*

ALPHABETICAL INDEX



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*The Symbol * Indicates An Illustration*

HANDBOOK

BASIC WEIGHT CHECK LIST
AND LOADING DATA

USAF SERIES
C-131A
AIRCRAFT

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS TECHNICAL PUBLICATION TO THE ATTENTION OF ALL PERSONNEL CLEARED FOR OPERATION OF AFFECTED AIRCRAFT AND EQUIPMENT.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

Los Angeles Lithograph Company, Inc. — 600 — 6-15-55

16 MAY 1955

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SECTION I

INTRODUCTION

1. This Technical Order contains a sample Basic Weight Check List and a Chart E, Loading Data, for assistance in complying with the requirements of the Handbook of Weight and Balance Data, AN 01-1B-40.

2. The sample Basic Weight Check List contained herein is to be used ONLY AS A GUIDE, in preparing check lists for insertion in the Handbook of Weight and Balance Data, AN 01-1B-40, for C-131A aircraft. If no other basic weight check list is available, a complete inventory of all equipment in the airplane must be made and a check mark placed in the proper column on a new set of basic weight check list pages.

3. The Chart E, Loading Data, contained herein replaces every Chart E for C-131A aircraft which is dated 30 days previous to the date of this publication, UNLESS SPECIFIC MODIFICATIONS NOT PROVIDED FOR IN THIS CHART E, LOADING DATA, HAVE BEEN MADE TO ANY AIRCRAFT OF THIS SERIES.

SECTION II — SAMPLE BASIC WEIGHT CHECK LIST

CHART A - BASIC WEIGHT CHECK LIST

PAGE 1 OF 22 PAGES
AIRPLANE MODEL C-131A
SERIAL NUMBER SAMPLE ONLY
DELIVERY DATE
FOR USE IN AN 01-1B-40
RECORD OF CHECKING (*Enter date*)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	1 CHART C ENTRY	2 IN AIRPLANE	2 CHART C ENTRY	3 IN AIRPLANE	3 CHART C ENTRY	4 IN AIRPLANE	4 CHART C ENTRY	5 IN AIRPLANE	5 CHART C ENTRY	6 IN AIRPLANE	6 CHART C ENTRY	7 IN AIRPLANE	7 CHART C ENTRY	8 IN AIRPLANE	8 CHART C ENTRY
	SECTION "A" - PILOT'S COMPARTMENT -																				
	STA. 42 - 109																				
A-1	Indicator - Directional Gyro (Type C-5B or C-5C)	7	49	0.3	✓																
A-2	Control Panel - C-824/AIC-10 (2)	7	73	0.5	✓																
A-3	Seat, Belt, & Reel - Pilot	42	84	3.5	✓																
A-4	Seat, Belt, & Reel - Copilot	42	84	3.5	✓																
A-5	Fire Extinguisher - Portable A - 20 (Chg. 4#)	8	103	0.8	✓																
A-6	Loudspeaker - LS-184 (2)	6	104	0.6	✓																
A-7	Oxy. Cyl. - Portable - Type A-6 (Chg. 1.2#)	5	104	0.5	✓																
A-8	Oxy. Cyl. - Portable - Type A-6 (Chg. 1.2#)	5	104	0.5	✓																

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DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 1 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 2 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING *(Enter date)*

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by Compartment)*	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "B" - RADIO AND GALLEY COMPARTMENT																				
	STA. 109 - 187																				
B-1	Control - C-626/ARC-27	9	114	1.0	✓																
B-2	Receiver - BC-453B	6	114	0.7	✓																
B-3	Antenna Coupler - 180L-2	18	116	2.1	✓																
B-4	Receiver - R-77/ARC-3	21	117	2.5	✓																
B-5	Control - K-4 (B-1A Vert. Gyro)	13	118	1.5	✓																
B-6	Jump Seat & Belt - Observer	10	118	1.2	✓																
B-7	Receiver - R322/ARN-18	13	120	1.6	✓																
B-8	Power Junction Box J-68	6	125	0.8	✓																
B-9	Dynamotor - DY-21	8	125	1.0	✓																
B-10	Dynamotor - DY-22	5	125	0.6	✓																
B-11	Colored Panels - Instrument Flying (6)	5	126	0.6	✓																
B-12	Dynamotor - DY-77	5	127	0.6	✓																
B-13	Dynamotor - DY-77	5	127	0.6	✓																
B-14	Receiver - Transmitter - 18S-4 & Mount	70	128	9.0	✓																
B-15	Transmitter - T-67B/ARC-3	22	131	2.9	✓																
B-16	Receiver Assy. - R101/ARN-6	37	132	4.9	✓																
B-17	Receiver Mount - MT 274	5	132	0.7	✓																
B-18	Amplifier - Compass Signal - C-1	12	132	1.6	✓																
B-19	Amplifier - MI-36A & Dynamotor	18	135	2.4	✓																
B-20	Receiver - R-122/ARN-12	8	135	1.1	✓																
B-21	Oxy. Cyl. #AF 44B24619 (Chg 1, 2#)	6	120	0.7	✓																
B-22	Oxy. Cyl. #AF 44B24619 (Chg 1, 2#)	6	120	0.7	✓																

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Chart A — Basic Weight Check List (Sheet 2 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 3 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "B" - RADIO AND BUFFET COMPARTMENT																				
	STA. 109 - 187																				
B-23	Drawers, Refuse Holder, Etc. - Buffet	5	151	0.8	✓																
B-24	Hot Cups - Buffet (4)	10	156	1.6	✓																
B-25	Buffet Structure & Refrigerator	303	163	49.4	✓																
B-26	Food, Liquid, & Food Service - Buffet	90	163	14.7	0																
B-27	Liquid Container - Buffet	15	169	2.5	✓																
B-28	Liquid Container - Buffet	15	176	2.6	✓																
B-29	Liquid Container - Buffet	15	183	2.7	✓																
B-30	Fire Extinguisher - Portable - A-20 (Chg 4.0#)	8	170	1.4	✓																
B-31	Attendants Seat & Belt - R.H. Single	30	176	5.3	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 3 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 4 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "C" - ELECTRICAL EQUIPMENT																				
	COMPARTMENT - STA. 187 - 237																				
C-1	Attendants Seat & Belt - L. H., Double	51	192	9.8	✓																
C-2	Control - Flight Vert. Gyro, Type K-6 or K-2	7	219	1.5	✓																
C-3	Control - Gyro Directional, Type S-3 or S-1	7	219	1.5	✓																
C-4	Amplifier - Autopilot - Type B-9	13	221	2.9	✓																
C-5	Regulator - Alternator Voltage Type L-4 (2)	18	221	4.0	✓																
C-6	Rack & Table - Autopilot	22	222	4.9	✓																
C-7	Table - Sliding - Attendant's	6	222	1.3	✓																
C-8	Amplifier - Autopilot - Type B-6	34	224	7.6	✓																
C-9	Amplifier - Autopilot - Type B-7A	5	219	1.1	✓																
C-10	Stanchion, Stra. 68 & Stra. 68-1, L. H.	12	232	2.8	O																
C-11	Safety Net - Attendant L. H.	8	228	1.8	✓																
C-12	Safety Net - Attendant R. H.	8	243	1.9	✓																

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DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 4 of 22)

CHART A - BASIC WEIGHT CHECK LIST

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

DELIVERY DATE

PAGE 5 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "D" - PASSENGER COMPARTMENT -																				
	STA. 237 - 285																				
D-1	Stanchion, Stra. 68 and Stra. 68-1 R.H.	12	249	3.0	O																
D-2	Passenger Seat & Belt - Double L.H.	51	250	12.8	✓																
D-3	Passenger Seat & Belt - Double R.H.	51	250	12.8	✓																
D-4	Modesty Curtain - Tier No. 1 L.H.	5	272	1.4	O																
D-5	Cargo Tie Down Net - Tier No. 1 L.H.	31	272	8.4	O																
D-6	Modesty Curtain - Tier No. 1 R.H.	5	288	1.4	O																
D-7	Cargo Tie Down Net - Tier No. 1, R.H.	31	288	8.9	O																

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DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 5 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 6 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (*Enter date*)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "E" - PASSENGER COMPARTMENT -																				
	STA. 285 - 330																				
E-1	Passenger Seat & Belt - Double L. H.	51	288	14.7	✓																
E-2	Passenger Seat & Belt - Double R. H.	51	288	14.7	✓																
E-3	Stanchion, Stra. 68 & Stra. 68-1 L. H.	12	312	3.7	O																
E-4	Passenger Seat & Belt - Double L. H.	51	326	16.6	✓																
E-5	Passenger Seat & Belt - Double R. H.	51	326	16.6	✓																
E-6	Stanchion, Stra. 68 & Stra. 68-1 L. H.	12	329	3.9	O																
E-7	Stanchion, Stra. 68 & Stra. 68-1 R. H.	12	329	3.9	O																

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DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 6 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 7 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "F" - PASSENGER COMPARTMENT -																				
	STA. 330 - 375																				
F-1	Stanchion, Stra. 68 & Stra. 68-1 - R. H.	12	345	4.1	O																
F-2	Passenger Seat & Belt - Double - L. H.	51	364	18.6	✓																
F-3	Passenger Seat & Belt - Double - R. H.	51	364	18.6	✓																
F-4	Modesty Curtain Tier 2 - L. H.	5	368	1.8	O																
F-5	Cargo Tie Down Net - Tier 2 - L. H.	31	368	11.4	O																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 7 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 8 OF22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "G" - PASSENGER COMPARTMENT -																				
	STA. 375 - 420																				
G-1	Modesty Curtain - Tier No. 2 - R. H.	5	384	1.9	0																
G-2	Cargo Tie Down Net - Tier No. 2 - R. H.	31	384	11.9	0																
G-3	Passenger Seat & Belt - Double - L. H.	51	402	20.5	✓																
G-4	Passenger Seat & Belt - Double - R. H.	51	402	20.5	✓																
G-5	Window Curtains (20)	12	408	4.9	✓																
G-6	Stanchion, Stra. 68 & Stra. 68-1 - L. H.	12	409	4.9	0																

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DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 8 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 9 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "H" - PASSENGER COMPARTMENT -																				
	STA. 420 - 465																				
H-1	Stanchion, Stra. 68 & Stra. 68-1 - L. H.	12	425	5.1	o																
H-2	Stanchion, Stra. 68 & Stra. 68-1 - R. H.	12	425	5.1	o																
H-3	Passenger Seat & Belt - Double - L. H.	51	440	22.4	✓																
H-4	Passenger Seat & Belt - Double - R. H.	51	440	22.4	✓																
H-5	Stanchion, Stra. 68 & Stra. 68-1 - R. H.	12	442	5.3	o																
H-6	Modesty Curtain - Tier 3 - L. H.	5	464	2.3	o																
H-7	Cargo Tie Down Net - Tier 3 - L. H.	31	464	14.4	o																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 9 of 22)

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 10 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	1 CHART C ENTRY	2 IN AIRPLANE	2 CHART C ENTRY	3 IN AIRPLANE	3 CHART C ENTRY	4 IN AIRPLANE	4 CHART C ENTRY	5 IN AIRPLANE	5 CHART C ENTRY	6 IN AIRPLANE	6 CHART C ENTRY	7 IN AIRPLANE	7 CHART C ENTRY	8 IN AIRPLANE	8 CHART C ENTRY
	SECTION "I" - PASSENGER COMPARTMENT -																				
	STA. 465 - 510																				
I-1	Passenger Seat & Belt - Double - L. H.	51	478	24.4	✓																
I-2	Passenger Seat & Belt - Double - R. H.	51	478	24.4	✓																
I-3	Modesty Curtain - Tier 3 - R. H.	5	480	2.4	O																
I-4	Cargo Tie Down Net - Tier 3 - R. H.	31	480	14.9	O																
I-5	Stanchion, Stra. 68 & Stra. 68-1 - L. H.	12	505	6.1	O																
I-6	Seat Support (240-3393113) - L. H.	10	510	5.1	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 10 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 11 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING *(Enter date)*

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by Compartment)*	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "J" - LITTER DOOR COMPARTMENT -																				
	STA. 510 - 560																				
J-1	Passenger Seat & Belt - Double - L.H.	51	516	26.3	✓																
J-2	Passenger Seat & Belt - Double - R.H.	51	516	26.3	✓																
J-3	Stanchion, Stra. 68 & Stra. 68-1 - R.H.	12	522	6.3	o																
J-4	Passenger Seat & Belt - Double - R.H.	51	554	28.3	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 11 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 12 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "K" - LITTER DOOR COMPARTMENT -																				
	STA. 560 - 610																				
K-1	Escape Slide & Stowage	19	590	11.2	✓																
K-2	Passenger Seat & Belt - Double - R. H.	51	592	30.2	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 12 of 22)

CHART A - BASIC WEIGHT CHECK LIST

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (*Enter date*)

PAGE 13 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "L" - FWD. LAVATORY & AFT LITTER																				
	COMPARTMENT - STA. 610 - 665																				
L-1	Stanchion (1) & Stra. 68-2 (2) - L. H.	8	616	4.9	✓																
L-2	Fire Extinguisher - Portable A-20	8	616	4.9	✓																
L-3	Modesty Curtain - Tier No. 4 - L. H.	5	656	3.3	o																
L-4	Cargo Tie Down Net - Tier No. 4 - L. H.	31	656	20.3	o																
L-5	Web Gate Ass'y. - Aft Litter Tier - L. H.	15	669	10.0	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 13 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 14 OF 22 PAGES
AIRPLANE MODEL C-131A
SERIAL NUMBER SAMPLE ONLY
DELIVERY DATE

FOR USE IN AN 01-1B-40
RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	CHECK 1 CHART C ENTRY	CHECK 2 IN AIRPLANE	CHECK 2 CHART C ENTRY	CHECK 3 IN AIRPLANE	CHECK 3 CHART C ENTRY	CHECK 4 IN AIRPLANE	CHECK 4 CHART C ENTRY	CHECK 5 IN AIRPLANE	CHECK 5 CHART C ENTRY	CHECK 6 IN AIRPLANE	CHECK 6 CHART C ENTRY	CHECK 7 IN AIRPLANE	CHECK 7 CHART C ENTRY	CHECK 8 IN AIRPLANE	CHECK 8 CHART C ENTRY
	SECTION "M" - AFT LAVATORY AND AFT LITTER																				
	COMPARTMENT - STA. 665 - 706																				
M-1	Water - Aft Lav. - 10 Gal.	83	666	55.3	○																
M-2	Chemicals - Lavatories	16	666	10.7	✓																
M-3	Net - Cargo Separation (240-3393953) 3	8	697	5.6	✓																
M-4	Stanchion (1) & Stra. 68-3 (2) L. H.	7	696	4.9	✓																
M-5	Container - Drinking Water	11	702	7.7	✓																
M-6	Water - Drinking - 2 Gal.	17	702	11.9	○																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 14 of 22)

CHART A - BASIC WEIGHT CHECK LIST

FOR USE IN AN 01-1B-40
RECORD OF CHECKING (Enter date)
DELIVERY DATE

PAGE 15 OF 22 PAGES
AIRPLANE MODEL C-131A
SERIAL NUMBER SAMPLE ONLY

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK															
						1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "N" - AFT STOWAGE COMPARTMENT																				
	STA. 706 - 744																				
N-1	Adapter - Litter Lift - Stowed	8	706	5.6	✓																
N-2	Litter Straps & Fittings - Stowed (28)	84	708	59.5	✓																
N-3	Aft Web Gate & (3) Stanchions	21	708	14.9	✓																
N-4	Cargo Net & Straps - Stowed (1)	31	720	22.3	✓																
N-5	Cargo Net & Straps - Stowed (1)	31	720	22.3	✓																
N-6	Cargo Net & Strap - Stowed (1)	31	720	22.3	✓																
N-7	Cargo Net & Strap - Stowed (1)	31	720	22.3	✓																
N-8	Modesty Curtain - Stowed (1)	5	725	3.6	✓																
N-9	Modesty Curtain - Stowed (1)	5	725	3.6	✓																
N-10	Modesty Curtain - Stowed (1)	5	725	3.6	✓																
N-11	Modesty Curtain - Stowed (1)	5	725	3.6	✓																
N-12	Litter Stanchions - Stowed (2)	10	739	7.4	✓																
N-13	Litter Stanchions - Stowed (2)	10	739	7.4	✓																
N-14	Litter Stanchions - Stowed (10)	53	739	39.2	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 15 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 16 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (*Enter date*)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "O" - TAIL COMPARTMENT -																				
	STA. 744 - 896																				
O-1	Receiver - Transmitter - RT-178/ARC-27	70	752	52.6	✓																
O-2	Dynamotor - DY-66/ARN-14	19	775	14.7	✓																
O-3	Transceiver - RT-82 - API-6	38	775	29.5	o																
O-4	Receiver - R-540 or R-541/ARN-14	30	779	23.4	✓																
O-5	Amplifier - AM-608/ARA-25	6	780	4.7	✓																
O-6	Antenna - Flush - ARN-14	12	793	9.5	✓																
O-7	Motor & Drive Ass'y - Servo-Rudder -																				
	Type A-1 Including Drum & Bracket Assy.	12	796	9.6	✓																
O-8	Motor & Drive Ass'y - Servo - Elevator -																				
	Type A-2 - Including Drum & Bracket Ass'y.	12	796	9.6	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 16 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 17 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING *(Enter date)*

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by Compartment)*	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "P" - NOSE CAP AND NOSE WHEEL WELL COMPARTMENT																				
P-1	Control Box - Nesa Glass (3)	9	20	0.2	✓																
P-2	Transformer 8L-16 (3)	8	26	0.2	✓																

1/ *Enter constant used below line.*

DD FORM 1 AUG 50 **365A**

Chart A — Basic Weight Check List (Sheet 17 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 18 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (Enter date)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (Grouped by Compartment)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	1 CHART C ENTRY	2 IN AIRPLANE	2 CHART C ENTRY	3 IN AIRPLANE	3 CHART C ENTRY	4 IN AIRPLANE	4 CHART C ENTRY	5 IN AIRPLANE	5 CHART C ENTRY	6 IN AIRPLANE	6 CHART C ENTRY	7 IN AIRPLANE	7 CHART C ENTRY	8 IN AIRPLANE	8 CHART C ENTRY
	SECTION "Q" - FORWARD ACCESSORY COMPARTMENT - STA. 109 - 340																				
Q-1	Pump - Hydraulic (Auxiliary) 112146-010-10	15	119	1.8	✓																
Q-2	Servo Control - Autopilot - Type O-2	16	125	2.0	✓																
Q-3	Accumulator - Hydraulic Press. - 406920	14	124	1.7	✓																
Q-4	Inverter - 500VA - AN3533-1	50	189	9.5	✓																
Q-5	Oxygen Bottle - Type G-1 (Charge 2.4#)	18	236	4.2	✓																
Q-6	Auto-Transformer - 8L-41	11	316	3.5	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 18 of 22)

RESTRICTED (*When filled in*)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 19 OF 22 PAGES | AIRPLANE MODEL C-131A | SERIAL NUMBER SAMPLE ONLY | DELIVERY DATE

FOR USE IN AN 01-1B-40 — RECORD OF CHECKING (*Enter date*)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1 IN AIRPLANE	1 CHART C ENTRY	2 IN AIRPLANE	2 CHART C ENTRY	3 IN AIRPLANE	3 CHART C ENTRY	4 IN AIRPLANE	4 CHART C ENTRY	5 IN AIRPLANE	5 CHART C ENTRY	6 IN AIRPLANE	6 CHART C ENTRY	7 IN AIRPLANE	7 CHART C ENTRY	8 IN AIRPLANE	8 CHART C ENTRY
	SECTION "R" - AFT ACCESSORY COMPARTMENT-																				
	STA. 392 - 744																				
R-1	Motor and Drive Ass'y. - Servo - OIHP																				
	104 to 1 Gear Ratio A-1 Aileron Including Drum &																				
	Bracket Ass'y. - Servo - Straight Control Arm																				
	Release	12	392	4.7	✓																
R-2	Heat Exchanger - Heating & Ventilating 80774	25	483	12.1	✓																
R-3	Oil Trapped (Oil that cannot be pumped from																				
	replenishing tank) Plus Oil in Lines From Replenishing																				
	Tank to Nacelle Tanks (See also W-31)	12	502	6.0	✓																
R-4	Secondary Compressor - 57590	22	503	11.1	✓																
R-5	Heat Exchanger - Heat. & Vent. - 18382-1	27	540	14.6	✓																
R-6	Ground Blower - #BLO-18	18	580	10.4	✓																
R-7	Cell - Oil Replenishing	21	636	13.4	✓																
R-8	Pump - CVAC PUM-68 - Oil Replenishing	8	640	5.1	✓																

1/ *Enter constant used below line.*

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 19 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 20 OF 22 PAGES

AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING *(Enter date)*

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION *(Grouped by Compartment)*	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK															
						1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "S" - OUTSIDE FUSELAGE																				
S-1	Mast - CVAC Ant. 36-17	6	115	0.7	✓																
S-2	Loop - ADF AS313B/ARN-6 & Housing	16	156	2.5	✓																
S-3	Antenna - AS-578/ARA-25	14	600	8.4	✓																

1/ *Enter constant used below line.*

DD FORM 1 AUG 50 **365A**

Chart A — Basic Weight Check List (Sheet 20 of 22)

CHART A - BASIC WEIGHT CHECK LIST

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AIRPLANE MODEL C-131A

SERIAL NUMBER SAMPLE ONLY

DELIVERY DATE

FOR USE IN AN 01-1B-40

RECORD OF CHECKING (*Enter date*)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		2		3		4		5		6		7		8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "W" - WING, POWER PLANT & NACELLE																				
W-1	Transmitter - Fuel Flowmeter 9061-11A (2)	7	284	2.0	✓																
W-2	Generator - Tachometer AN5547-2 (2)	6	289	1.7	✓																
W-3	Pump - Main Hyd. System PF-17-3911-25ZE (2)	14	289	4.0	✓																
W-4	Hyd. Pump Fixed Disp. 011227-060-01 (1)	6	290	1.7	✓																
W-5	Pump - Fuel 2P771-C-2 (2)	8	294	2.4	✓																
W-6	Gear Box - Alt. - Gen. Drive & Cabin Press.																				
	#GE 167-1 (2)	24	295	7.1	✓																
W-7	Starter AN4116R6 (2)	56	298	6.7	✓																
W-8	Alternator - Engine Driven 115V Single																				
	Phase Type C-3 (1)	53	299	15.8	✓																
W-9	Generator - Engine Driven 300 AMP-R-3 (1)	56	299	16.7	✓																
W-10	Hyd. Pump Variable #PUM 77-7 (2)	45	299	13.5	✓																
W-11	Actuator - Residual Heat Door EE-4330 (2)	9	318	2.9	✓																
W-12	Alternator - Type C-3 115V Single Phase	53	320	17.0	✓																
W-13	Generator 300 Amp Type R-3	56	320	17.9	✓																
W-14	Gear Box - Alt. & Gen. Drive (1)	15	331	5.0	✓																
W-15	Light Assy. - Landing G-38003-1 (2)	13	335	4.4	✓																
W-16	Pump - Propeller Feathering 66166-6 (2)	29	336	9.7	✓																

1/ Enter constant used below line.

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 21 of 22)

CHART A - BASIC WEIGHT CHECK LIST

PAGE 22 OF 22 PAGES
AIRPLANE MODEL C-131A
SERIAL NUMBER SAMPLE ONLY
DELIVERY DATE
FOR USE IN AN 01-1B-40
RECORD OF CHECKING (*Enter date*)

COMPARTMENT AND ITEM NUMBER	ITEMS AND LOCATION (*Grouped by Compartment*)	WEIGHT	ARM	1/ MOMENT / 1000	DELIVERY EQUIPMENT	CHECK 1		CHECK 2		CHECK 3		CHECK 4		CHECK 5		CHECK 6		CHECK 7		CHECK 8	
						IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY	IN AIRPLANE	CHART C ENTRY
	SECTION "W" - WING, POWER PLANT & NACELLE (Cont)																				
W-17	Motor CVAC MO-53	22	338	7.4	✓																
W-18	Pump - Fuel Booster 121026-022-04 (1)	14	365	5.1	✓																
W-19	Pump - Fuel Booster 121026-021-04 (1)	14	365	5.1	✓																
W-20	Actuator - Augmentor Vanes 477A (1)	5	400	2.0	✓																
W-21	Actuator - Agumentor Vanes 477C (1)	5	400	2.0	✓																
W-22	Cooler - AiResearch 87088-125-03 (1)	15	406	6.1	✓																
W-23	Compressor, Primary 57550 (1)	61	410	25.0	✓																
W-24	Battery - Aircraft Exide 12V Type GFH-13 (2)	159	407	64.7	✓																
W-25	Filter - Alternator - Generator Drive (1)	11	409	4.5	✓																
W-26	Filter - Cabin Pressurization (1)	11	415	4.6	✓																
W-27	Cooler - AiResearch 87087-125-23 (1)	10	419	4.2	✓																
W-28	Pump - Water Injection RD-8500-G4 (1)	7	438	3.1	✓																
W-29	Fire Extinguisher C-B #870225 (2) Chg. 13.5# ea	52	473	24.6	✓																
W-30	Fuel Trapped (When Drained from Main Drain With Airplane in Level Condition)	53	379	20.1	✓																
W-31	Oil - Trapped (That Which Does Not Drain From Tank Drain) Plus Four Gallons Reserve Propeller Feathering Oil in Tanks (See also Item R-3)	204	274	55.9	✓																

1/ *Enter constant used below line.*

DD FORM 1 AUG 50 365A

Chart A — Basic Weight Check List (Sheet 22 of 22)

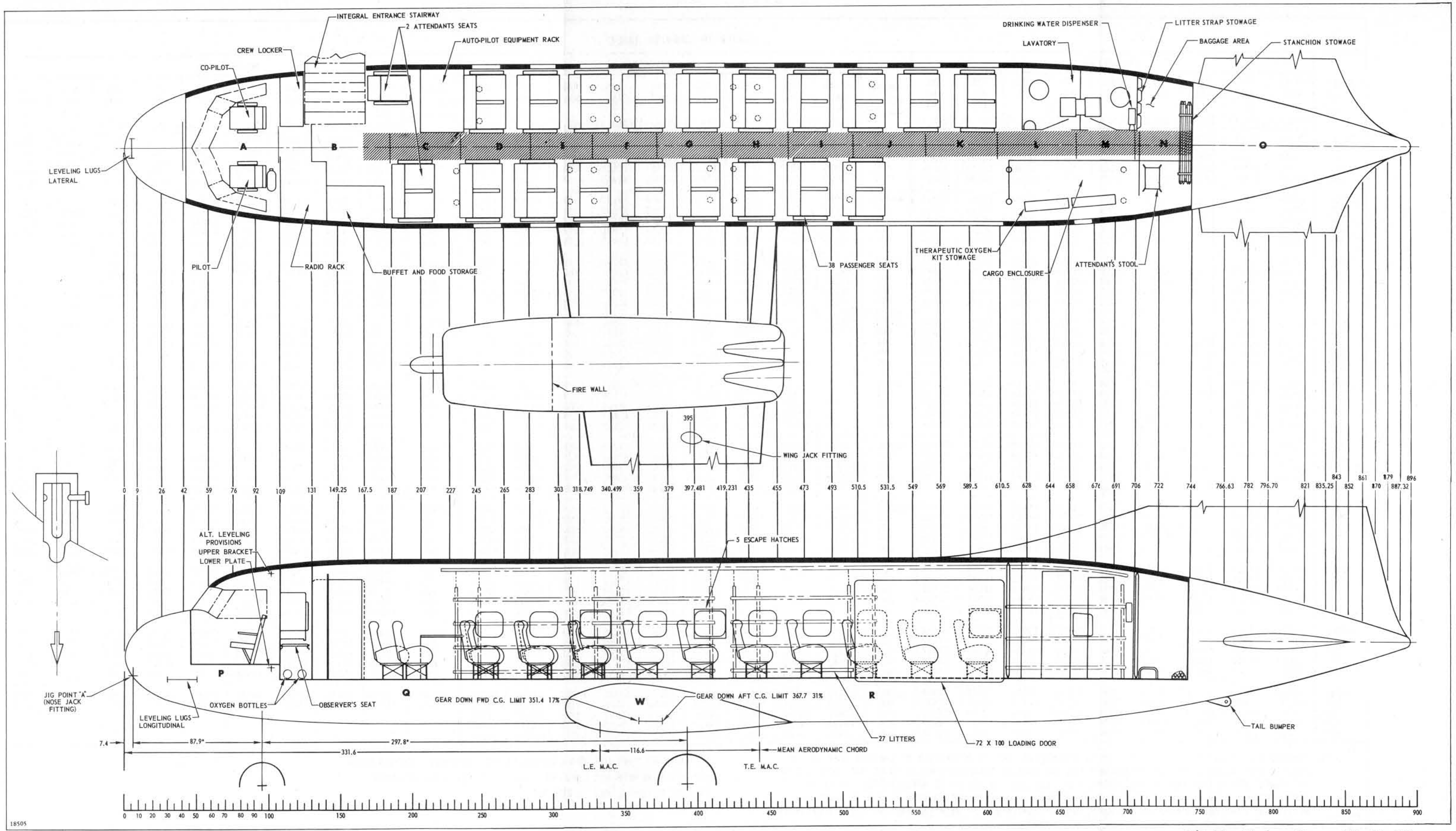

Chart E — Airplane Diagram (Sheet 1 of 6)

SECTION III

CHART E, LOADING DATA

NOTES

(1) The airplane is approximately level when the struts are in static position. Exact level may be obtained by compressing or extending the nose strut. Struts are normal to centerline of airplane. Therefore the strut extension does not vary the horizontal distance between wheels.

(2) Measurements may be taken to locate the reactions during weighings by dropping a plumb bob from jig point fitting "A" at Sta. 7.4, and measure to centerline of nose and main landing gear wheels.

(3) Shaded area used in conjunction with cargo capacity table (Ref Sheet 5).

(4) *Dimensions based on actual measurements of commercial 240 airplanes.

CENTER OF GRAVITY TABLE

GROSS WEIGHT (POUNDS)	MOMENT/1000								
	13.0% MAC (1) (346.8)	17% MAC (2) (351.4)	19% MAC (353.8)	21% MAC (356.1)	24% MAC (359.6)	27% MAC (363.1)	29% MAC (365.4)	31% MAC (3) (367.7)	33% MAC (4) (370.1)
29000	10137	10191	10260	10327	10428	10530	10597	10663	10733
100	10172	10226	10296	10363	10464	10566	10633	10700	10770
200	10207	10261	10331	10398	10500	10603	10670	10737	10807
300	10241	10296	10366	10434	10536	10639	10706	10774	10844
400	10276	10331	10402	10469	10572	10675	10743	10810	10881
29500	10311	10366	10437	10505	10608	10711	10779	10847	10918
600	10345	10401	10472	10541	10644	10748	10816	10884	10955
700	10380	10437	10508	10576	10680	10784	10852	10921	10992
800	10415	10472	10543	10612	10716	10820	10889	10957	11029
900	10449	10507	10579	10647	10752	10857	10925	10994	11066
30000	10484	10542	10614	10683	10788	10893	10962	11031	11103
100	10519	10577	10649	10719	10824	10929	10999	11068	11140
200	10553	10612	10685	10754	10860	10966	11035	11105	11177
300	10588	10647	10720	10790	10896	11002	11072	11141	11214
400	10623	10683	10756	10825	10932	11038	11108	11178	11251
30500	10657	10718	10791	10861	10968	11075	11145	11215	11288
600	10692	10753	10826	10897	11004	11111	11181	11252	11325
700	10727	10788	10862	10932	11040	11147	11218	11288	11362
800	10761	10823	10897	10968	11076	11183	11254	11325	11399
900	10796	10858	10932	11003	11112	11220	11291	11362	11436
31000	10831	10893	10968	11039	11148	11256	11327	11399	11473
100	10865	10929	11003	11075	11184	11292	11364	11435	11510
200	10900	10964	11039	11110	11220	11329	11400	11472	11547
300	10935	10999	11074	11146	11255	11365	11437	11509	11584
400	10970	11034	11109	11182	11291	11401	11474	11546	11621
31500	11004	11069	11145	11217	11327	11438	11510	11583	11658
600	11039	11104	11180	11253	11363	11474	11547	11619	11695
700	11074	11139	11215	11288	11399	11510	11583	11656	11732
800	11108	11175	11251	11324	11435	11547	11620	11693	11769
900	11143	11210	11286	11360	11471	11583	11656	11730	11806
32000	11178	11245	11322	11395	11507	11619	11693	11766	11843
100	11212	11280	11357	11431	11543	11656	11729	11803	11880
200	11247	11315	11392	11466	11579	11692	11766	11840	11917
300	11282	11350	11428	11502	11615	11728	11802	11877	11954
400	11316	11385	11463	11538	11651	11764	11839	11913	11991
32500	11351	11421	11499	11573	11687	11801	11876	11950	12028
600	11386	11456	11534	11609	11723	11837	11912	11987	12065
700	11420	11491	11569	11644	11759	11873	11949	12024	12102
800	11455	11526	11605	11680	11795	11910	11985	12061	12139
900	11490	11561	11640	11716	11831	11946	12022	12097	12176
33000	11524	11596	11675	11751	11867	11982	12058	12134	12213
100	11559	11631	11711	11787	11903	12019	12095	12171	12250
200	11594	11666	11746	11823	11939	12055	12131	12208	12287
300	11628	11702	11782	11858	11975	12091	12168	12244	12324
400	11663	11737	11817	11894	12011	12128	12204	12281	12361
33500	11698	11772	11852	11929	12047	12164	12241	12318	12398
600	11732	11807	11888	11965	12083	12200	12277	12355	12435
700	11767	11842	11923	12001	12119	12236	12314	12391	12472
800	11802	11877	11958	12036	12154	12273	12351	12428	12509
900	11837	11912	11994	12072	12190	12309	12387	12465	12546
34000	11871	11948	12029	12107	12226	12345	12424	12502	12583
100	11906	11983	12065	12143	12262	12382	12460	12539	12620
200	11941	12018	12100	12179	12298	12418	12497	12575	12657
300	11975	12053	12135	12214	12334	12454	12533	12612	12694
400	12010	12088	12171	12250	12370	12491	12570	12649	12731
34500	12045	12123	12206	12285	12406	12527	12606	12686	12768
600	12079	12158	12241	12321	12442	12563	12643	12722	12805
700	12114	12194	12277	12357	12478	12600	12679	12759	12842
800	12149	12229	12312	12392	12514	12636	12716	12796	12879
900	12183	12264	12348	12428	12550	12672	12752	12833	12916
35000	12218	12299	12383	12464	12586	12709	12789	12870	12954
100	12253	12334	12418	12499	12622	12745	12826	12906	12991
200	12287	12369	12454	12535	12658	12781	12862	12943	13028
300	12322	12404	12489	12570	12694	12817	12899	12980	13065
400	12357	12440	12525	12606	12730	12854	12935	13017	13102
35500	12391	12475	12560	12642	12766	12890	12972	13053	13139
600	12426	12510	12595	12677	12802	12926	13008	13090	13176
700	12461	12545	12631	12713	12838	12963	13045	13127	13213
800	12495	12580	12666	12748	12874	12999	13081	13164	13250
900	12530	12615	12701	12784	12910	13035	13118	13200	13287
36000	12565	12650	12737	12820	12946	13072	13154	13237	13324
100	12599	12686	12772	12855	12982	13108	13191	13274	13361
200	12634	12721	12808	12891	13018	13144	13227	13311	13398
300	12669	12756	12843	12926	13053	13181	13264	13348	13435
400	12704	12791	12878	12962	13089	13217	13301	13384	13472
36500	12738	12826	12914	12998	13125	13253	13337	13421	13509
600	12773	12861	12949	13033	13161	13289	13374	13458	13546
700	12808	12896	12894	13069	13197	13326	13410	13495	13583
800	12842	12932	13020	13104	13233	13362	13447	13531	13620
900	12877	12967	13055	13140	13269	13398	13483	13568	13657
37000	12912	13002	13091	13176	13305	13435	13520	13605	13694
100	12946	13037	13126	13211	13341	13471	13556	13642	13731
200	12981	13072	13161	13247	13377	13507	13593	13678	13768
300	13016	13107	13197	13283	13413	13544	13629	13715	13805
400	13050	13142	13232	13318	13449	13580	13666	13752	13842
37500	13085	13178	13268	13354	13485	13616	13703	13789	13879
600	13120	13213	13303	13389	13521	13653	13739	13826	13916
700	13154	13248	13338	13425	13557	13689	13776	13862	13953
800	13189	13283	13374	13461	13593	13725	13812	13899	13990
900	13224	13318	13409	13496	13629	13761	13849	13936	14027
38000	13258	13353	13444	13532	13665	13798	13885	13973	14064
100	13293	13388	13480	13567	13701	13834	13922	14009	14101
200	13328	13423	13515	13603	13737	13870	13958	14046	14138
300	13362	13459	13551	13639	13773	13907	13995	14083	14175
400	13397	13494	13586	13674	13809	13943	14031	14120	14212
38500	13432	13529	13621	13710	13845	13979	14068	14156	14249
600	13466	13564	13657	13745	13881	14016	14104	14193	14286
700	13501	13599	13692	13781	13917	14052	14141	14230	14323
800	13536	13634	13727	13817	13952	14088	14178	14267	14360
900	13571	13669	13763	13852	13988	14125	14214	14304	14397
39000	13605	13705	13798	13888	14024	14161	14251	14340	14434
100	13640	13740	13834	13924	14060	14197	14287	14377	14471
200	13675	13775	13869	13959	14096	14234	14324	14414	14508
300	13709	13810	13904	13995	14132	14270	14360	14451	14545
400	13744	13845	13940	14030	14168	14306	14397	14487	14582
39500	13779	13880	13975	14066	14204	14342	14433	14524	14619
600	13813	13915	14010	14102	14240	14379	14470	14561	14656
700	13848	13951	14046	14137	14276	14415	14506	14598	14693
800	13883	13986	14081	14173	14312	14451	14543	14634	14730
900	13917	14021	14117	14208	14348	14488	14579	14671	14767
40000	13952	14056	14152	14244	14384	14524	14616	14708	14804
100	13987	14091	14187	14280	14420	14560	14653	14745	14841
200	14021	14126	14223	14315	14456	14597	14689	14782	14878
300	14056	14161	14258	14351	14492	14633	14726	14818	14915
400	14091	14197	14294	14386	14528	14669	14762	14855	14952
40500	14125	14232	14329	14422	14564	14706	14799	14892	14989
600	14160	14267	14364	14458	14600	14742	14835	14929	15026
700	14195	14302	14400	14493	14636	14778	14872	14965	15063
800	14229	14337	14435	14529	14672	14814	14908	15002	15100
900	14264	14372	14470	14564	14708	14851	14945	15039	15137
41000	14299	14407	14506	14600	14744	14887	14981	15076	15174
100	14333	14443	14541	14636	14780	14923	15018	15112	15211
200	14368	14478	14577	14671	14816	14960	15054	15149	15248
300	14403	14513	14612	14707	14851	14996	15091	15186	15285
400	14438	14548	14647	14743	14887	15032	15128	15223	15322
41500	14472	14583	14683	14778	14923	15069	15164	15260	15359
600	14507	14618	14718	14814	14959	15105	15201	15296	15396
700	14542	14653	14753	14849	14995	15141	15237	15333	15433
800	14576	14689	14789	14885	15031	15178	15274	15370	15470
900	14611	14724	14824	14921	15067	15214	15310	15407	15507
42000	14646	14759	14860	14956	15103	15250	15347	15443	15544
100	14680	14794	14895	14992	15139	15287	15383	15480	15581
200	14715	14829	14930	15027	15175	15323	15420	15517	15618
300	14750	14864	14966	15063	15211	15359	15456	15554	15655
400	14734	14899	15001	15099	15247	15395	15493	15590	15692
42500	14819	14935	15037	15134	15283	15432	15530	15627	15729
600	14854	14970	15072	15170	15319	15468	15566	15664	15766
700	14888	15005	15107	15205	15355	15504	15603	15701	15803
800	14923	15040	15143	15241	15391	15541	15639	15738	15840
900	14958	15075	15178	15277	15427	15577	15676	15774	15877
43000	14992	15110	15213	15312	15463	15613	15712	15811	15914
100	15027	15145	15249	15348	15499	15650	15749	15848	15951
200	15062	15180	15284	15384	15535	15686	15785	15885	15988
300	15096	15216	15320	15419	15571	15722	15822	15921	16025
400	15131	15251	15355	15455	15607	15759	15858	15958	16062
43500	15166	15286	15390	15490	15643	15795	15895	15995	16099
575	15192	15312	15417	15517	15670	15822	15922	16023	16127

(1) FORWARD FLIGHT LIMIT - WHEELS UP - 13.0%. MOMENT/1000 DUE TO RETRACTION OF LANDING GEAR IS -80. MOMENT/1000 VALUES LISTED IN THIS COLUMN ARE THE MOMENTS CORRESPONDING TO 13.0% MAC INCREASED BY THE MOMENT FOR RETRACTION OF THE LANDING GEAR, AND ARE EQUIVALENT TO APPROXIMATELY 15.4% MAC AT 29000 POUNDS TO 14.6% MAC AT 43575 POUNDS LOADINGS, BASED ON WHEELS DOWN CONDITION WHICH FALL WITHIN THE LIMITING MOMENTS IN THE TABLE, WILL BE SATISFACTORY WHEN THE LANDING GEAR IS RETRACTED.

(2) FORWARD TAKE-OFF AND LANDING LIMIT - 17% MAC - WHEELS DOWN

(3) AFT TAKE-OFF AND LANDING LIMIT - 31% MAC - WHEELS DOWN

(4) AFT FLIGHT LIMIT IS 33% MAC

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Chart E — Center of Gravity Table (Sheet 2 of 6)

FUEL TABLE

GALLONS	WEIGHT	MOMENT/1000	GALLONS	WEIGHT	MOMENT/1000	GALLONS	WEIGHT	MOMENT/1000
10	60	23	510	3060	1159	1010	6060	2296
20	120	45	520	3120	1182	1020	6120	2319
30	180	68	530	3180	1205	1030	6180	2342
40	240	91	540	3240	1228	1040	6240	2364
50	300	114	550	3300	1250	1050	6300	2387
60	360	136	560	3360	1273	1060	6360	2410
70	420	159	570	3420	1296	1070	6420	2433
80	480	182	580	3480	1319	1080	6480	2455
90	540	205	590	3540	1341	1090	6540	2478
100	600	227	600	3600	1364	1100	6600	2501
110	660	250	610	3660	1387	1110	6660	2523
120	720	273	620	3720	1410	1120	6720	2546
130	780	296	630	3780	1432	1130	6780	2569
140	840	318	640	3840	1455	1140	6840	2592
150	900	341	650	3900	1478	1150	6900	2614
160	960	364	660	3960	1500	1160	6960	2637
170	1020	386	670	4020	1523	1170	7020	2660
180	1080	409	680	4080	1546	1180	7080	2683
190	1140	432	690	4140	1569	1190	7140	2705
200	1200	455	700	4200	1591	1200	7200	2728
210	1260	477	710	4260	1614	1210	7260	2751
220	1320	500	720	4320	1637	1220	7320	2774
230	1380	523	730	4380	1660	1230	7380	2796
240	1440	546	740	4440	1682	1240	7440	2819
250	1500	568	750	4500	1705	1250	7500	2842
260	1560	591	760	4560	1728	1260	7560	2864
270	1620	614	770	4620	1751	1270	7620	2887
280	1680	637	780	4680	1773	1280	7680	2910
290	1740	659	790	4740	1796	1290	7740	2933
300	1800	682	800	4800	1819	1300	7800	2955
310	1860	705	810	4860	1841	1310	7860	2978
320	1920	727	820	4920	1864	1320	7920	3001
330	1980	750	830	4980	1887	1330	7980	3024
340	2040	773	840	5040	1910	1340	8040	3046
350	2100	796	850	5100	1932	1350	8100	3069
360	2160	818	860	5160	1955	1360	8160	3092
370	2220	841	870	5220	1978	1370	8220	3115
380	2280	864	880	5280	2001	1380	8280	3137
390	2340	887	890	5340	2023	1390	8340	3160
400	2400	909	900	5400	2046	1400	8400	3183
410	2460	932	910	5460	2069	1410	8460	3205
420	2520	955	920	5520	2092	1420	8520	3228
430	2580	978	930	5580	2114	1430	8580	3251
440	2640	1000	940	5640	2137	1440	8640	3274
450	2700	1023	950	5700	2160	1450	8700	3296
460	2760	1046	960	5760	2182	1460	8760	3319
470	2820	1068	970	5820	2205	1470	8820	3342
480	2880	1091	980	5880	2228	1480	8880	3365
490	2940	1114	990	5940	2250	1490	8940	3387
500	3000	1137	1000	6000	2273	1500	9000	3410

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MAXIMUM CAPACITY 1500 GALLONS
ARM - 378.9 INCHES FROM H.R.L.

Chart E — Fuel Table (Sheet 3 of 6)

CREW & PATIENT (OR PASSENGER) TABLE

BASED ON 180 LBS PER MAN FOR CREW & PASSENGERS
AND 230 LBS PER MAN FOR LITTER PATIENT & LITTER

		WEIGHT	ARM	MOMENT/1000
PILOTS	(2)	360	84	30
ATTENDANTS				
FEMALE ROW 1 R.H.	(1)	130	176	23
MALE ROW 1 L.H.	(1)	180	192	35
LITTERS & LITTER PATIENTS	(27)			
LEFT HAND				
ROW 1	(4)	920	272	250
ROW 2	(4)	920	368	339
ROW 3	(4)	920	464	427
ROW 4	(3)	690	656	453
RIGHT HAND				
ROW 1	(4)	920	288	265
ROW 2	(4)	920	384	353
ROW 3	(4)	920	480	442
SEATED PASSENGERS	(37)			
ROW 1 L.H. - PASSENGER OR ATTENDANT	(1)	180	192	35
ROW 2 L. & R.H.	(4)	720	250	180
ROW 3 L. & R.H.	(4)	720	288	207
ROW 4 L. & R.H.	(4)	720	326	235
ROW 5 L. & R.H.	(4)	720	364	262
ROW 6 L. & R.H.	(4)	720	402	289
ROW 7 L. & R.H.	(4)	720	440	317
ROW 8 L. & R.H.	(4)	720	478	344
ROW 9 L. & R.H.	(4)	720	516	372
ROW 10 R.H.	(2)	360	554	199
ROW 11 R.H.	(2)	360	592	213

OIL TANKS

NACELLE TANKS

ARM - 323"

GALLONS	WEIGHT	MOMENT/1000
5	38	12
10	75	24
15	113	36
20	150	48
25	188	61
30	225	73
35	263	85
40	300	97

OIL REPLENISHING TANK

ARM - 636"

GALLONS	WEIGHT	MOMENT/1000
5	38	24
10	75	48
15	113	72
20	150	95
22	165	105

POWER PLANT WATER TABLE

ARM - 440"

GALLONS	WEIGHT	MOMENT/1000
5	37	16
10	75	33
15	112	49
20	149	66
25 (Max)	187	82

Chart E — Crew and Patient Loading Table, Oil Table, Power Plant Water Table (Sheet 4 of 6)

CARGO CAPACITY TABLE

(CAPACITY LOADINGS BASED ON NO PASSENGERS OR PATIENTS ABOARD)

COMPARTMENT	C	D	E	F	G	H	I	J	K	L	M	N
COMPARTMENT LENGTH	187 TO 237	237 TO 285	285 TO 330	330 TO 375	375 TO 420	420 TO 465	465 TO 510	510 TO 560	560 TO 610	610 TO 665	665 TO 706	706 TO 744
CENTROID	210	261	307	352	398	443	487	535	585	637	685	724
WEIGHT POUNDS	MOMENT/1000 FOR COMPTS AT CENTROIDS NOTED											
20	4	5	6	7	8	9	10	11	12	13	14	14
40	8	10	12	14	16	18	19	21	23	25	27	29
60	13	16	18	21	24	27	29	32	35	38	41	43
80	17	21	25	28	32	35	39	43	47	51	55	58
100	21	26	31	35	40	44	49	54	59	64	69	72
200	42	52	61	70	80	89	97	107	117	127	137	145
300	63	78	92	106	119	133	146	161	176	191	206	217
400	84	104	123	141	159	177	195	214	234	255	274	290
500	105	131	154	176	199	222	244	268	293	319	343	362
600	126	157	184	211	239	266	292	321	351	382		434
700	147	183	215	246	279	310	341	375	410	446		507
800	168	209	246	282	318	354	390	428	468			
900	189	235	276	317	358	399	438	482	527			
1000	210	261	307	352	398	443	487	535	585			
1100	231	287	338	387	438	487	536	589	644			
1200		313	368	422	478	532	584	642	702			
1300		339	399	458	517	576	633	696	761			
1400		365		493	557	620	682	749	819			
1500								803	878			
1600								856	936			
1700								910	995			
1800								963	1053			
1900								1017	1112			
2000								1070	1170			
2100								1124	1229			
2200								1177	1287			
2300								1231	1346			
2400								1284	1404			
2500								1338	1463			
2600								1391	1521			
2700								1445	1580			
2800								1498	1638			
2900								1552	1697			
3000									1755			
3100												

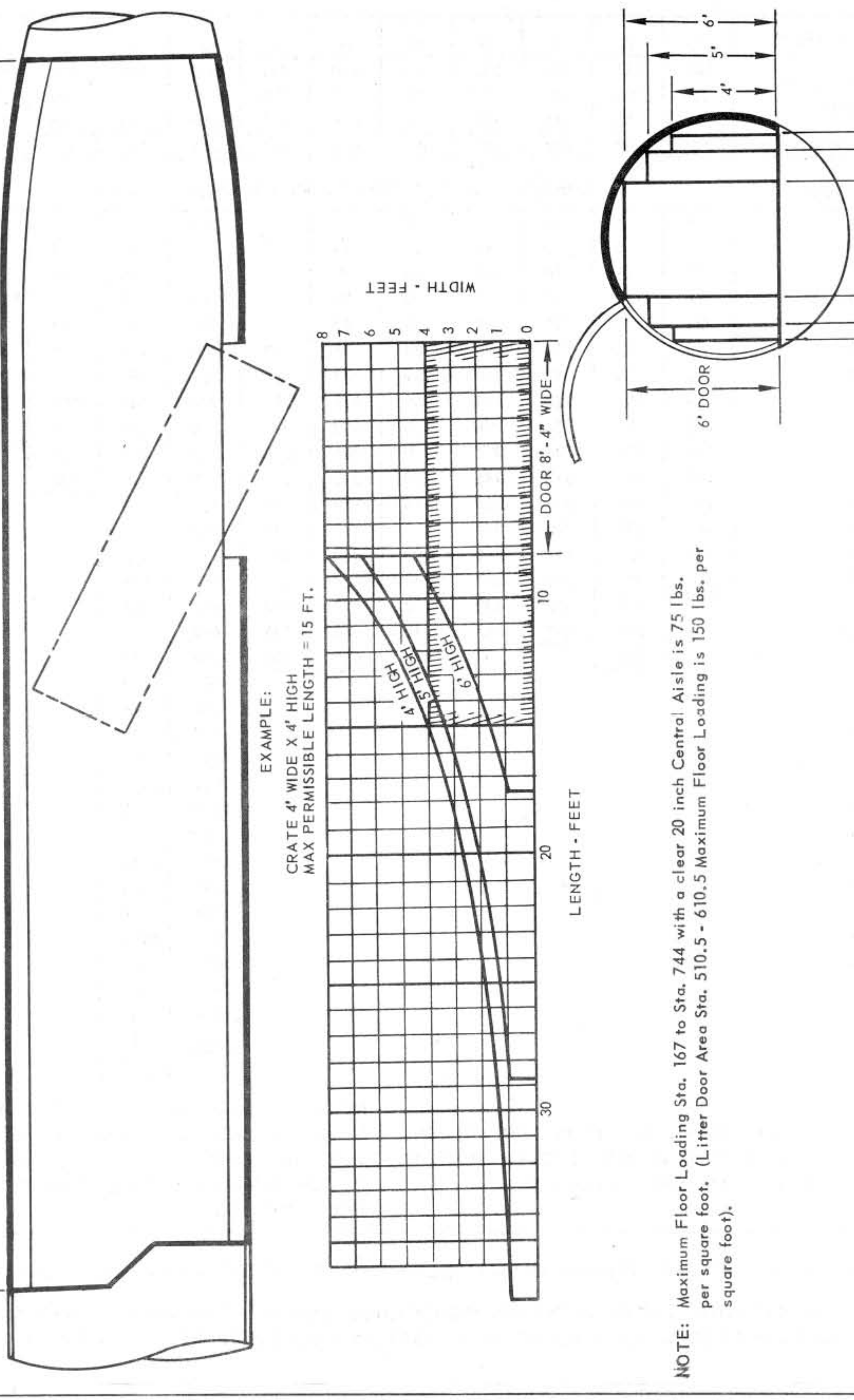
NOTE: TOTAL WEIGHT IN COMPARTMENT J THRU N MUST NOT EXCEED 3800 LBS WITH LAVATORIES INSTALLED.

NOTE: TOTAL WEIGHT IN COMPARTMENT L AND M (WEB GATE COMPARTMENT L.H.) MUST NOT EXCEED 800 LBS. TOTAL WEIGHT IN COMPARTMENT L THRU N MUST NOT EXCEED 1300 LBS.

(1) KEEP SHADED AREA CLEAR - 20 INCH CENTRAL AISLE - FROM STA 167 TO STA 744. (SEE E CHART SHEET 1)

(2) CARGO LOADING LIMITS AS SHOWN ABOVE ARE WITH "A" CHART EQUIPMENT INSTALLED. CARGO LOADINGS MAY BE INCREASED IF AN EQUIVALENT WEIGHT OF "A" CHART EQUIPMENT IS REMOVED FROM SUBJECT COMPARTMENT.

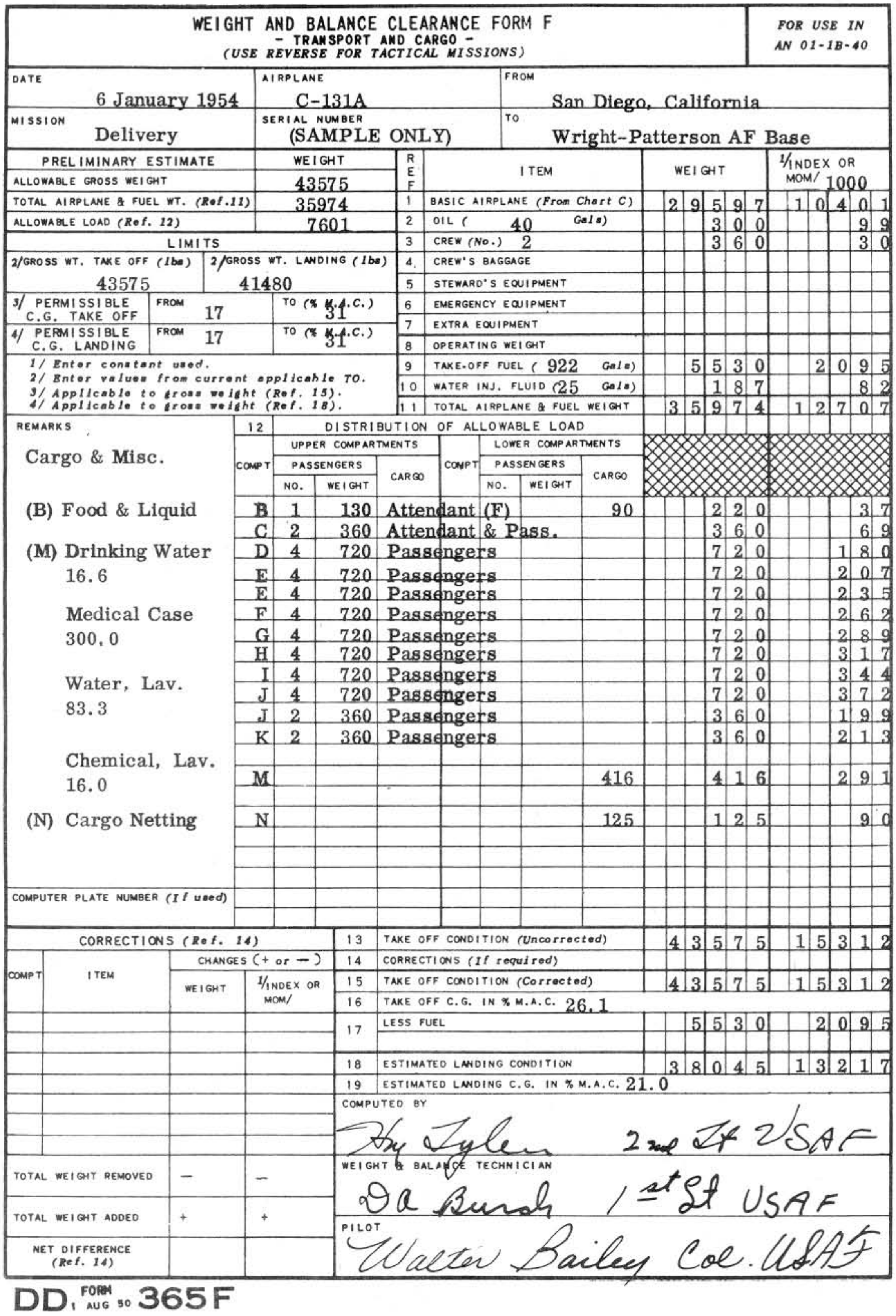
Chart E — Cargo Capacity Table (Sheet 5 of 6)



EXAMPLE:
CRATE 4' WIDE X 4' HIGH
MAX PERMISSIBLE LENGTH = 15 FT.

NOTE: Maximum Floor Loading Sta. 167 to Sta. 744 with a clear 20 inch Central Aisle is 75 lbs. per square foot. (Litter Door Area Sta. 510.5 - 610.5 Maximum Floor Loading is 150 lbs. per square foot).

Chart E — Maximum Package Size Table (Sheet 6 of 6)



WEIGHT AND BALANCE CLEARANCE FORM F
- TRANSPORT AND CARGO -
(USE REVERSE FOR TACTICAL MISSIONS)

FOR USE IN AN 01-1B-40

DATE 6 January 1954	AIRPLANE C-131A	FROM San Diego, California
MISSION Delivery	SERIAL NUMBER (SAMPLE ONLY)	TO Wright-Patterson AF Base

PRELIMINARY ESTIMATE	WEIGHT
ALLOWABLE GROSS WEIGHT	43575
TOTAL AIRPLANE & FUEL WT. *(Ref.11)*	35974
ALLOWABLE LOAD *(Ref. 12)*	7601

LIMITS

2/GROSS WT. TAKE OFF *(lbs)* 43575		2/GROSS WT. LANDING *(lbs)* 41480	
3/ PERMISSIBLE C.G. TAKE OFF	FROM 17	TO (% M.A.C.) 31	
4/ PERMISSIBLE C.G. LANDING	FROM 17	TO (% M.A.C.) 31	

1/ Enter constant used.
2/ Enter values from current applicable TO.
3/ Applicable to gross weight (Ref. 15).
4/ Applicable to gross weight (Ref. 18).

REF	ITEM	WEIGHT	1/INDEX OR MOM/ 1000
1	BASIC AIRPLANE *(From Chart C)*	29597	10401
2	OIL (40 *Gals)*	300	99
3	CREW *(No.)* 2	360	30
4	CREW'S BAGGAGE		
5	STEWARD'S EQUIPMENT		
6	EMERGENCY EQUIPMENT		
7	EXTRA EQUIPMENT		
8	OPERATING WEIGHT		
9	TAKE-OFF FUEL (922 *Gals)*	5530	2095
10	WATER INJ. FLUID (25 *Gals)*	187	82
11	TOTAL AIRPLANE & FUEL WEIGHT	35974	12707

REMARKS

Cargo & Misc.

(B) Food & Liquid

(M) Drinking Water
16.6

Medical Case
300.0

Water, Lav.
83.3

Chemical, Lav.
16.0

(N) Cargo Netting

COMPUTER PLATE NUMBER *(If used)*

12 DISTRIBUTION OF ALLOWABLE LOAD

UPPER COMPARTMENTS				LOWER COMPARTMENTS					
COMPT	PASSENGERS NO.	PASSENGERS WEIGHT	CARGO	COMPT	PASSENGERS NO.	PASSENGERS WEIGHT	CARGO		
B	1	130	Attendant (F)				90	220	37
C	2	360	Attendant & Pass.					360	69
D	4	720	Passengers					720	180
E	4	720	Passengers					720	207
E	4	720	Passengers					720	235
F	4	720	Passengers					720	262
G	4	720	Passengers					720	289
H	4	720	Passengers					720	317
I	4	720	Passengers					720	344
J	4	720	Passengers					720	372
J	2	360	Passengers					360	199
K	2	360	Passengers					360	213
M							416	416	291
N							125	125	90

CORRECTIONS *(Ref. 14)*

COMPT	ITEM	CHANGES (+ or −) WEIGHT	CHANGES (+ or −) 1/INDEX OR MOM/
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE *(Ref. 14)*			

13	TAKE OFF CONDITION *(Uncorrected)*	43575	15312
14	CORRECTIONS *(If required)*		
15	TAKE OFF CONDITION *(Corrected)*	43575	15312
16	TAKE OFF C.G. IN % M.A.C. 26.1		
17	LESS FUEL	5530	2095
18	ESTIMATED LANDING CONDITION	38045	13217
19	ESTIMATED LANDING C.G. IN % M.A.C. 21.0		

COMPUTED BY
Hy Tyler 2nd Lt USAF

WEIGHT & BALANCE TECHNICIAN
Da Bursh 1st Lt USAF

PILOT
Walter Bailey Col. USAF

DD FORM 1 AUG 50 365F

Weight and Balance Clearance Form F — Transport and Cargo